Gas Journal

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Editorial Notes

The New Refractories Specifications

THE quality of refractory materials is of paramount importance to the Gas Industry. Consequently, many gas engineers will have hastened to familiarize themselves with the new specifications to which we made reference last week and of which we give extracts in this issue. The specifications have been published by the Institution of Gas Engineers and have been prepared by the Refractory Materials Joint Sub-Committee of the Institution and the Society of British Gas Industries, together with representatives of the British Refractories Research Association. It is thus evident that they are as authoritative as is possible. The far-sightedness shown by those responsible for earlier editions of the specifications is evidenced by the fact that revisions are required only at long intervals. Indeed, there are by no means a few gas-works in which there are at work settings built during the currency of the first edition issued in 1912, though, of course, they are operated at lower temperatures than are customary in the case of modern carbonizing plant. At the same time, it must not be forgotten that, from time to time, individual contractors and undertakings have anticipated changes which have ultimately been incorporated in new editions of the specifications. We have no doubt that, if carbonizing requirements become more exacting in the near future, similar steps will again be taken. Thus a new specification consolidates the ground which has been won as a result of pioneering work and, in addition, goes a long way towards covering future requirements.

The trend in successive specifications has been to attach progressively greater importance to the adequate kiln-firing of the bricks. At the same time, the original and unnecessarily exacting requirements for refractoriness have been released, though no further concessions have been made in this respect in the new specifications. It must be remembered that the " refractoriness safety test " embodied in the specifications is a very drastic one, since the samples must survive this ordeal by fire without showing any sign of fusion.

The manufacturers have again co-operated heartily in meeting the demands of the Carbonizing Industry for improved refractory materials. This is evidenced by the fact that they have agreed to the adoption of 1,450° C. as the temperature for the after-expansion test for silica material, in place of 1,410° C., and by the fact that stricter limits are imposed as regards variations from the specified dimensions in all classes of products. These are steps in the right direction and their importance needs no stressing. The " retort material " of earlier specifications has disappeared and in its place is a section devoted to " moulded fireclay and siliceous retorts." Retorts in segmental form come within the specifications for silica, siliceous, or fireclay bricks, blocks, or tiles. This is in better harmony with present-day conditions. Reference is made to a group of special refractory materials, but no specifications for their quality are laid down. It will be seen that there are no changes of a revolutionary nature, nor, indeed, were changes of such a character necessary.

Better Arrangement

THE arrangement of the new specifications in incomparably superior to that previously adopted. In earlier editions, the clauses of the specifications were interspersed with descriptions of test methods in a very confusing manner. A systematic arrangement has now been adopted. The specifications for the individual classes of material come first and are followed by a general description of the methods by which the various tests are to be applied. A useful table—a new feature—summarizing the whole of the specifications is followed by notes on additional tests not included in the specifications but nevertheless of great importance. It is pointed out that it has still not been found possible to specify under-load requirements for refractory materials for gas-works. The reason for this is that work on this subject is not yet sufficiently advanced to enable agreed standard tests to be laid down for the various groups of material. In the present state of knowledge, if any test were prescribed it would have to err on the side of leniency and would thus be of doubtful use. It is therefore just as well that a refractoriness-under-load test does not form part of the specifications. However, some notes are given on the various methods available for the test.

We heartily endorse the advice given in the Introduction to the specification to engineers who adopt these specifications—namely, that they should take care that they are adhered to strictly, since it is only in this way that continued improvement in the quality of refractory material is to be expected.

Courage and Enterprise

THE paper which Mr. C. W. Surman presented at the meeting of the Irish Association of Gas Managers, and which will be found on later pages of our issue to-day, is a welcome complement to his contribution to the same Association a couple of years ago. In 1932 Mr. Surman dealt with sales methods adopted at Ballymena; in his present paper he turns his attention to the works side of the picture and explains what he has done during the past seven years to ensure a supply of gas of uniform quality, economically produced, and at adequate pressure to make satisfaction secure. His record is excellent; it provides an admirable example of the reward of courage and enterprise and should inspire others to put into practice a similar policy. And it shows that efficient gas manufacture and administration are not the sole prerogative of the large undertaking.

Consider what Mr. Surman has accomplished in the short span since 1927, when he took charge of the Ballymena undertaking. At the time the sales of gas amounted to 37 million c.ft. a year and the price ranged from 7s. 6d. to 6s. 9d. per 1,000 c.ft. In 1933 the sales were 59 millions and the price ranged from 2s. per 1,000 c.ft. for industrial purposes to 3s. and 4s. 6d. for domestic use according to particular purpose. This amounts roughly to a 50% increase in sales and a 50% reduction in price—no small achievement in the space of seven years, and when it is borne in mind that many alterations in plant, involving considerable capital expenditure, had to be tackled. But Mr. Surman faced this boldly and adopted the policy which for long we have advocated in these columns—anticipatory costing. He found out at what price he could afford to sell gas *with the added load*, instead of losing profitable business by basing his prices on the existing output. It will be noted, too, that a few weeks ago the Ballymena Council adopted an optional multi-part tariff scheme—another incentive to increased sales, of the success of which we have no doubt.

A Paying Proposition

MR. SURMAN'S paper is a thoroughly practical one packed with hints for the manager of the smaller concern. We like, for example, the author's comments on coal blending, which is apt to result in "sandwiching" rather than anything in the nature of a blend; and we like his insistence on the fact that attention to detail work throughout the gas-works saves money. It is unquestionably well worth while to exercise the closest control over every detail and carry out a systematic maintenance programme. In this respect we may call attention to his remarks on maintenance of exhausters, for on the smaller works enough care is not always taken to ensure efficiency in the functioning of exhausting machinery. Here is a good example where trouble and money spent on maintenance are amply repaid by the more regular and efficient results obtained in the retort house.

The best results in any gas-works can, of course, be gained only by strict chemical control. The smaller works cannot afford trained chemists and well-equipped laboratories, but they can do a great deal in a small way. Space can be set aside for some simple testing apparatus which is simple to manipulate after certain fundamental principles have been grasped, and the knowledge gained by its use can make profits for the undertaking. It is essential, of course, that the results obtained should be rightly interpreted; otherwise they are worse than useless. For which reason we advise the youth of the Gas Industry in Ireland—and we realize the peculiar obstacles in that country—to do all possible to follow the curricula laid down by the Institution of Gas Engineers in their Education Scheme. As Mr. Hyslop mentioned in his Presidential Address, which was published in the "JOURNAL" last week, it is disappointing to find that the number of candidates as yet supplied by Ireland is negligible. "It is admitted," he observed, "that facilities for technical education are few and far between, and approved courses, on account of geographical conditions, are out of the question; but if the thirst for knowledge really exists, it is not impossible to find ways and means of overcoming these handicaps." To our mind it is imperative that the handicaps should be surmounted, and we look to those responsible for small undertakings, as well as the executives of the larger concerns, in co-operation and with help from the national bodies, to find a way. Mr. Surman is certainly the type of man to encourage youth.

District Pressures

WE do not intend to comment in detail on the many things which Mr. Surman has done to bring his plant up to date, but we would refer to two points in his paper. The first is really a confession—and a proper one—that boosting plant to ensure adequate district pressures at all times is to be regarded as a palliative rather than a cure. The cause all too often lies in the fact that gasholders of certain nominal capacities are unable to throw the requisite pressures when uncupped. Take the case at Ballymena. Mr. Surman had two holders, each of a "capacity" of 60,000 c.ft. As a matter of fact the useful working capacity of both these holders together was only 60,000 c.ft.; after that, uncupping occurred, with disastrous results to the district supply. At certain times during the winter of 1927 it was necessary to have each holder full to blowing-point; the throughput of the retorts had to be increased at these periods, and an extra retort had to be brought into operation—all of which added to cost and decreased efficiency. A booster was installed which "saved the situation," but Mr. Surman took the bull by the horns and installed a holder capable of throwing 6 in. W.G. when uncupped and 9 in. when fully inflated. The stated capacity of 150,000 c.ft. is its working capacity; and the savings effected by its erection, as set out by the author, are convincing.

The other point concerns cleanliness of works. Mr. Surman says that untidy gas-works may in fact be efficient and well run. We believe that untidy works, if made tidy—as they can so easily be made by a little organization—immediately become more efficient. The whole atmosphere changes, and it affects all employed at the works, from manager to syphon-pumper. We regard this as by no means a minor point in successful gas-works practice.

The Gas Unit

WE publish in our Correspondence Columns to-day two further letters on the subject of the adoption of a small gas unit. One of the correspondents has no doubt that we are right in our advocacy of a unit of 3,412 B.Th.U., if a small unit is deemed advisable, rather than one of 4,000 B.Th.U. The other letter, from Mr. J. Taylor, of Weston-super-Mare, expresses the view that it is best to stick to the good old Therm, which has a thermal equivalent of 29·3 Board of Trade electricity units. It is quite obvious that the question is one of great interest to the Industry, and we think we are serving a useful

purpose by ventilating the matter in the "JOURNAL." We understand that the whole position of the gas unit is being reviewed and will be further debated at the meeting of the Central Executive Board of the National Gas Council next October. In the meantime we shall welcome the views of our readers on the question, in the belief that their publication cannot do otherwise than benefit our Industry.

Housing of Wage Earners

IN whatever direction one looks, new building estates are seen to be in process of formation, if not completely laid out, and regularly the issue of one's favourite newspaper sets forth the very latest propositions in "luxury homes." An astonishingly small amount of cash will "secure," and the weekly payments over a lengthy period of years necessary to transform the tenant from a tenant-owner into an independent owner are set forth in plain figures. All very tempting, of course. On their industry the builders are to be commended, but, be as industrious as they may, they never appear able to overtake the housing problem. As fast as one aspect is faced up to, another presents itself.

House purchase, judiciously embarked upon, in suitable circumstances, is a first-class form of thrift, in addition to offering other obvious advantages; but nevertheless there are, and must remain, innumerable cases in which the buying of one's residence is undesirable, if not actually out of the question. In the first place, the transaction must be well within one's means, and inseparably linked with this is the need for reasonable security of position of the buyer, which, unhappily, cannot invariably be part and parcel of commercial activity when business conditions the world over are less stable than was the case before the war. Then, from one cause or another, it may at some future date become essential to move away from one locality to another, and anyone likely to be so circumstanced might find himself fettered by having purchased a house. These are some of the reasons which make it certain that, however alluring may be the proposals of the designers of building estates, there will be no lack of applicants to rent dwellings rather than buy them. Therefore the tenant, as distinct from the landlord, must always be "in the picture."

An Opportunity for Gas

IN the "JOURNAL" for June 20, in the course of an editorial note on the nation's housing needs, reference was made to the first report of the Council for Research on Housing Construction, whose work had its origin in a number of private investigations directed to the common end of reducing the costs of housing through the fuller use of modern structural methods and materials. Mention was made then of the Council's estimate that an annual production for Great Britain of 250,000 dwellings for at least five, and probably ten, years is not incommensurate with the need, provided that of this number not less than four-fifths are for the working-class population, and at least 150,000 are built *to let* at rents within the rent-paying capacity of the lower-paid workers. Thus an enormous amount of new work is envisaged—even though, in view of slum-clearance programmes and normal wearing-out, &c., of existing property, the report does not suggest a net increase of 250,000 houses a year—and of this work we enjoined the Gas Industry to be careful to secure a good share. The position in this respect is clearly indicated by the Council, in the remark that the most suitable positions for gas fire flues have been shown in all their plans, "but choice between gas and electricity and between many possible types of equipment must be made on local considerations of relative costs of supply."

Plan Ahead

THE Council for Research on Housing Construction discuss in their report the practicability of a suitably centralized system for the supply of hot water and heating to working-class flats, but, to quote Sir Percy Alden (Chairman of the British Institute of Social Service), dwellings for wage-earners must have the amenities and conveniences which gas undertakings can supply. The Gas Industry must have it all planned-out. While the owner-occupier will in all probability be keenly sympathetic towards suggestions for hire-purchase of appliances, the working man who rents his dwelling is less likely to want to become the owner of his gas-consuming apparatus. He will probably prefer a prepayment meter and fittings scheme, but even so there will be gas fires to be considered, with everything on an appropriate basis. The dwellings must be available at a rent which the tenant can afford to pay, and the equipment must be judged by the same standard. As to what this rent should be, one must be guided largely by the town or district in which the dwellings are situated and the class of work in which the occupiers are likely to be engaged. But the National Housing Committee, who also have been considering the subject, are desirous of seeing erected, at the earliest possible date, "many hundreds of thousands of houses, to be let to low-paid wage-earners at inclusive rentals not exceeding 10s. a week." In order to meet this rent requirement, the cost of building must be kept as low as possible, and, as we have just said, everything must be in keeping.

Fifty Years After

A FEW days ago, while diligently searching the "JOURNAL" files of half a century back for an elusive reference, our eye chanced upon an article which forcibly reminded us of the saying, *Nihil sub sole novi.* It is an interesting coincidence that almost exactly fifty years before the widespread electricity failure which was commented upon in these columns last week, a similar, though naturally far less extensive, breakdown prompted our then leader-writer to discourse in the "JOURNAL" editorial pages to the extent of a full column in protest against what he termed "the vagaries of electric lighting systems."

It was on Aug. 7, 1884, that the Duke of Buckingham and Chandos, who earlier on that day had presented the medals and diplomas to the successful competitors in the Gas Section of the previous year's Electric and Gas Exhibition at the Crystal Palace, dined at the Health Exhibition, of which he was President, with the enterprising firm of engineers who provided the steam machinery for supplying the electric lighting of "this popular resort of heated Londoners." A complimentary notice of the event appeared in the London newspapers the following morning, in which the chief data relating to the installation were given. Thus it was told how engines developed 1,300 H.P., and ran for a long time without a hitch or any variation of speed; also, how the electric lighting plant generally was the most complete that had ever been brought together.

There was something peculiar, however, in the stress laid by the Duke upon the good conduct of the crowd upon Bank Holiday, when—according to a report of His Grace's remarks—the people, numbering 70,000 "evacuated the building with only a glimmer of the

electric light to aid them, peaceably, and without damaging even a plant or flower." What was the meaning of this mysterious reference to a "glimmer" of light? Simply this: At about 9 o'clock on the evening in question, when the Exhibition was thronged and the gaiety was at its height, the whole of the electric lamps went out—and remained out for forty minutes.

But even in those far off days we witness the beginnings of the greater enlightenment which was to come. Fifty years ago there were those who had sufficient foresight to employ the only thoroughly reliable form of illumination as a stand-by; for, our comment continued, most fortunately the precaution had been observed of keeping a few gas burners alight along the principal exits; and it was these, as well as the good behaviour of the crowd, that saved the executives of the Exhibition from the reproach of bringing grave loss, or still more grave disaster to life and limb, on their patrons. In addition to this awkward reminder of the uncertainties of electric lighting, there had already been four small fires at the "Healthieries," three of which had been caused by the short-circuiting of the electric supply. This, however, we suggested, tended to keep the fire staff on the alert, and so was, perhaps, from one point of view, a very good thing.

The writer's concluding philosophical comment on this occurrence, and others that had happened at the Crystal Palace and elsewhere, was to suggest that by that time an ordinary English crowd had become so far used to the vagaries of electric lighting systems as to preserve a calmness during the sudden extinctions that seemed destined to disconcert electricians just when their light was most needed. One may well wonder to what extent this is still true to-day.

Personal

RETIREMENT OF MR. H. E. COPP, M.INST.C.E.

As already stated in these columns, Mr. H. E. Copp, Engineer and Manager of the Hull Station of the British Gas Light Company, Ltd., will retire in September and so sever a connection of twenty years' standing with the Company. Mr. Copp is the youngest son of the late Mr. W. L. Copp, who was closely associated for many years with the Gas Industry in the West of England and was the inventor of the first anti-clip valve for attachment to hydraulic mains, which was used extensively by London Gas Companies about fifty years ago. Educated at Wycliffe College, Mr. Harold Copp began his career in the Gas Industry in 1892 as a pupil under the late Mr. Fletcher W. Stevenson, at that time Engineer to the Sheffield Gas Company. Later, he acted as clerk of works on the construction of the Grimethorpe Station of the Sheffield Gas Company, and acquired considerable experience on large civil engineering works. He studied at Sheffield University College, gaining certificates in technical subjects, including civil engineering, metallurgy, and chemistry.

In 1896, Mr. Copp left Sheffield to become Engineering Assistant to the Stockport Gas and Electricity Department, and was subsequently appointed Assistant Gas and Electrical Engineer. In 1902 he went to West Bromwich to take charge of the Corporation Gas Undertaking, where he designed and carried out many important improvements and additions to the works. He was elected President of the Midland Association of Gas Managers in 1908. Mr. Copp's first connection with the British Gas Light Company, Ltd., was in 1914, when he was appointed Engineer and Manager of the Potteries Station, where he was responsible for the erection of one of the first plants for the production of benzole and toluol. On the retirement of Mr. John Young in 1919, Mr. Copp was transferred to the Hull Station.

Mr. Copp was President of the Institution of Gas Engineers in 1930-31, and presided at the First International Gas Conference held in London on June 3, 1931.

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At a recent meeting of the Council of the County Borough of West Bromwich, tributes were paid to the energetic work of the GAS ENGINEER and MANAGER (Mr. J. Hunter Rioch) since he took up his present appointment eleven months ago. It was agreed to confirm a unanimous recommendation of the Gas Committee that the salary of Mr. Rioch be increased by £100 per annum as from Sept. 1, 1934, and by £50 each year to £950 per annum.

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Mr. ROBERT W. KERSHAW, Assistant Distribution Superintendent to the Blackpool Corporation Gas Department, has been appointed Distribution Manager to the Gloucester Gas Light Company.

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At the funeral service of Mr. J. W. AUCHTERLONIE, held at St. Columba's Church, Downing Street, Cambridge, on Aug. 13, the Eastern Counties Gas Managers' Association was represented by the President (Mr. F. G. Brockway), and Messrs. F. Prentice, Thos. Glover, W. W. Townsend, J. H. Troughton, P. D. Walmsley, A. W. Sumner, F. M. Paternoster, F. H. Robinson, H. R. Thomas (Assistant Engineer, Cambridge), J. Green, and W. C. Chapman (Hon. Secretary and Treasurer).

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Mr. J. C. COTTERILL, who has recently been appointed Engineer and Secretary to the Okehampton Gas Company, Ltd., and Secretary to the Bude Gas Company, was educated at King Edward's Grammar School, Aston, Birmingham, where he passed the Matriculation examination with Distinctions in Mathematics and French. After two years spent in the shops at Messrs. Tangyes and the laboratories at West Bromwich Technical School, he was apprenticed to Mr. C. F. W. Rendle at the Redditch Gas-Works for three years. At the end of this term he was retained as Junior Works Assistant, and during the next five years had a varied experience, including the management of a small works purchased by the Redditch Gas Company. In 1931 he obtained the post of Technical Assistant to the Worcester New Gaslight Company, and while there received a comprehensive experience of works routine and sales training. In 1931 he obtained the Diploma in Gas Engineering, 2nd Class, of the Institution of Gas Engineers, and is an Associate Member of the Institution.

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On leaving Motherwell to take up duty as Gas and Water Engineer at Windermere, Mr. JAMES LECKIE, Assistant Gas Manager to the Motherwell Corporation, has been presented by the staff with a writing bureau and a work table for Mrs. Leckie.

Obituary

The death occurred on Aug. 15 of Mr. E. J. RATCLIFFE, an old and valued servant of Messrs. John Wright & Co., Ltd., of Essex Works, Birmingham. For many years Mr. Ratcliffe represented his firm's interests in the South-West of England, only retiring in June last owing to ill health. Deceased was well known in the Gas Industry and highly respected by all with whom he came in contact.

Forthcoming Engagements.

Sept. 1-4.—SECOND INTERNATIONAL GAS CONFERENCE, Zurich.
Sept. 6.—NORTH BRITISH ASSOCIATION OF GAS MANAGERS.—Annual Meeting in Inverness.
Sept. 7.—SOUTHERN ASSOCIATION (WESTERN DISTRICT).—Commercial Meeting at Dartmouth, 2.30 p.m.
Sept. 11.—I.G.E.—Finance Sub-Committee, 9.45 a.m.; Membership Sub-Committee, 10.30 a.m.; General Purposes Committee, 11.15 a.m.; Gas Education Executive Committee, 4 p.m.
Sept. 17-20.—ASSOCIATION OF PUBLIC LIGHTING ENGINEERS.—Eleventh Annual Meeting at Aberdeen.
Sept. 20.—I.G.E.—Refractory Materials Joint Sub-Committee (Stoke-on-Trent), 2.30 p.m.
Sept. 20.—WALES AND MONMOUTHSHIRE ASSOCIATION OF GAS ENGINEERS AND MANAGERS.—General Meeting at Porthcawl.
Sept. 24-26.—B.C.G.A.—Annual General Meeting and Conference at Sheffield.
Sept. 27.—I.G.E.—Liquor Effluents and Ammonia Sub-Committee, 2.30 p.m.

Correspondence

The Gas Unit

SIR,—As a matter of interest, in the consideration of the Unit system of charging for gas, the following figures based on the position at Weston-super-Mare may be worth noting.

Present price of gas, 9½d. per therm.

Equivalent prices.

Unit of 3,412 B.Th.U., 0·32414d.
Unit of 4,000 B.Th.U., 0·38d.

If the price of gas were reduced to 9d. per therm, these equivalents would be 0·30708d. and 0·36d. respectively. It appears to me that the public would be much more difficult to educate in the significance of a pricing system calling for the use of five places of decimals than they were at the time of the introduction of the therm system, and only in a less degree to a system which requires two decimals. The British public follows the late Lord Randolph Churchill in its dislike for decimals, and for my own part I prefer to instruct my salesmen that a therm of gas contains the same number of heat units as 29 Board of Trade Units of electricity, rather than to adopt a system by which the public might have to be informed, if the price of gas were reduced, that the reduction would amount to the microscopical quantity of 0·01706d. per unit.

Yours, &c.,
JAS. TAYLOR,
Engineer and General Manager.

Weston-super-Mare and District Gas Company,
Aug. 17, 1934.

SIR,—I should like to express my entire agreement with your Editorial on this important subject. There is no question but that the only value which can be called "rational" is 3,412 B.Th.U., but the important point is that we simply cannot afford to give away 14% of the calorific value of our gas.

Yours, &c.,
"IN COMPETITION."

Aug. 17, 1934.

News In Brief

New Showrooms are to be opened by the Dumfries Gas Department, for which purpose they have leased a shop in Castle Street.

The Post of Secretary is vacant at the Dowlais Gas and Coke Company, and the Directors are prepared to consider applications for the position.

The Tully Gas at Horncastle has a calorific value of 360 B.Th.U. and not of 300 B.Th.U. as was stated on page 360 of last week's issue.

Dividends are Announced by the South Shields Gas Company for the half-year ended June, 1934, at the rate of 4¼% on the consolidated stock and 2⅞% on the ordinary stock, both less income-tax.

With the Object of Arranging Contracts to supply gas over a period of years, the Chairman and Deputy-Chairman and the Gas Manager of the Dukinfield Gas Department have been deputed to interview certain bulk consumers.

New Offices in Commercial Street, Dundee, will be taken over by the Dundee Gas Department in October. The Public Lighting Department is to take over the premises in Irving Square at present occupied by the Gas Department.

The Electric Light Failed at the Leas Cliff Hall, Folkestone, on the night of Aug. 16, during the course of a dancing act by Mme. Markova. During the breakdown, which lasted half an hour, the waitresses had to carry lighted candles round on their trays when serving the refreshments.

Welded Joints Throughout exemplify the modern tendency in steel construction in the new gasholder recently completed by Messrs. Clayton, Sons, & Co., Ltd., of Leeds, for I.C.I., Ltd., at their Billingham works. The welding electrodes were "Ironex" and "Belfinish" by Murex Welding Processes, Ltd., of London.

An Agreement has been Reached between the Lanark County Council and the Motherwell and Wishaw Town Council over the question of the supply of gas to Waterloo housing scheme. The County Council disagreed with a clause in the proposed agreement making the County body financially responsible if there was a reduction in the consumption of gas after five years. The Town Council have now agreed to supply the gas without sharing any responsibility with the County Council.

The Lighting Superintendent of Oslo has visited Whitley Bay to inspect the street lighting in the town, which is claimed to be the best gas lighted town in the North-East area. The visitor called at the offices of the Newcastle-upon-Tyne and Gateshead Gas Company and was taken to Whitley Bay. Deputations from local authorities have also inspected the lighting system. The lights have been fixed with a new kind of refractor which spread the light exactly on the road where it is wanted.

A Seven Years' Contract for the street lighting of Malden has been placed with the Malden Gas Light Company. The contract provides for the lighting of some new areas recently incorporated within the Borough, and for this purpose the Gas Company are laying 2½ miles of main. It is gratifying to note that in the new areas gas is replacing electricity for the street lighting.

We Acknowledge the Receipt of a copy of "Red Lead Paint, its Uses and Advantages," from the United Kingdom Lead Oxide Convention. The purpose of the publication is to furnish data and information in regard to the use of red lead paint, which will be useful to those responsible for the protection of iron and steel structures. The claims of red lead paint for such structures as gasholders, where the action of air and moisture increase the rate and degree of corrosion, are set forth in this interesting book.

Two Courses, each of ten discussion classes, have been organized by the National Institute of Industrial Psychology. The subject of the first course is "The Engagement, Training, and Supervision of Workers," and the classes will be held at 6.15 p.m. on Tuesdays, starting on Oct. 2, 1934. The course is planned for labour managers, departmental managers, welfare superintendents, foremen and forewomen. The second course is concerned with Conditions and Methods of Work, which will also be held on Tuesdays, starting on Jan. 15, 1935.

The Annual Prize Distribution to employees of the Newport (Mon.) Gas Company who were successful in the competition for the best cultivated allotments and gardens took place on Friday, Aug. 17, at the Crindau Works. The judge said that the efforts of the gardeners were all the more praiseworthy since they had had to contend with a very dry season. Among those present were: Mr. T. Spittle, J.P., Vice-Chairman, who occupied the chair, Mr. R. Wilson Bartlett, J.P., and Dr. T. Morrell Thomas, Directors, Mr. J. H. Canning, O.B.E., J.P., Engineer and Manager, Mr. J. F. Rust, Assistant Engineer, and Mr. R. S. Snelling, F.C.I.S.

Bye-Product Coking Plant for Cardiff.—The British (Guest Keen Baldwins) Iron and Steel Company, Ltd., have placed with the Woodall-Duckham Company the contract for the large bye-product coking plant which they are installing in connection with the re-oganization of their Cardiff works. The contract includes a battery of Becker coke ovens divided into two sections. The ovens will be arranged so that they can be heated either by blast furnace or by coke oven gas as required, and will have a total net production capacity of 5,850 tons of blast furnace coke a week. The contract also comprises the supply of all oven machinery, a reinforced concrete oven storage bunker for 2,400 tons of washed coal, a coke quenching station and wharf, and complete bye-product plant for recovery of crude tar, sulphate of ammonia, and benzole. The benzole plant will provide for rectification of crude benzole to motor fuel.

Further News Items will be found on Following Pages.

Dundee's Gasholder Now Satisfactory.

Completion of Ten Months' Test.

After a ten months' test, Lochee's once-tilted gasholder has been pronounced satisfactory.

The holder was repaired and readjusted, the work being completed last October. In a report to the Dundee Corporation Gas Committee, Mr. John Wilson, the Gas Engineer, states that levels taken periodically since the repair show that no movement has taken place.

Interesting details concerning the repairs are given in the report, which states that 1,627 tons of material were injected under the foundations of the holder, of which 490 tons were cement. The cost of putting the holder into commission was £5,545, of which £5,042 was paid to the Francois Cementation Company, Ltd., which included the cost of cement and materials. The expense to the Department was approximately £300.

The work took five months to complete, and the process was to bore holes through and outside the existing foundation down to the solid rock, through which the material for consolidation was injected by water pressure. The whole area of the quarry underneath and supporting the foundation was thus solidified.

The Gas Department was responsible for making good the portions of the tank and gasholder affected by the subsidence.

Second International Gas Conference.

British Delegates.

The undermentioned British Delegates had been registered up to Aug. 20 for the 2nd International Gas Conference to be held in Zurich from Sept. 1 to 4 next, further particulars of which can be obtained from the Secretary of the Institution of Gas Engineers, 28, Grosvenor Gardens, S.W. 1:

J. R. W. Alexander, M.A., LL.B. (London).
Sir H. W. Russell Bencraft, J.P. (Southampton).
C. Valon Bennett (Rochester).
Mrs. C. Valon Bennett.
P. Valon Bennett (Rochester).
H. E. Bennet, M.C. (London).
R. W. Broadhead (London).
Edwin Fletcher, B.A. (London).
Edward J. Fottrell, B.Sc. (London).
W. Fergus Harris (Edinburgh).
F. W. Hayter (Southampton).
J. C. Hosken, B.A. (London).
James Jamieson (Edinburgh).
Clifford A. King (London; "GAS JOURNAL").
Mrs. Clifford A. King.
F. Mitchell (Beeston).
Mrs. F. Mitchell.
Walter Muter (Edinburgh).
G. V. Perry (Tanworth-in-Arden).
Joseph H. Race (Farnworth).
Charles S. Shapley (Leeds).
Mrs. Charles S. Shapley.
A. H. Silcox (London; *Gas World*).
A. C. Slaughter (London; *Gas Times*).
H. Stanier, B.A. (London).
E. P. Stevenson (London).
Mrs. E. P. Stevenson.
B. S. Stevenson (London).
Frank P. Tarratt (Newcastle-upon-Tyne).
Mrs. Frank P. Tarratt.
Ronald L. Tarratt, B.Sc. (Newcastle-upon-Tyne).
J. Stanley Thorman (Southall).
W. W. Townsend (Colchester).
Mrs. W. W. Townsend.
Ernest West (Manchester).
Mrs. Ernest West.
S. E. Whitehead, B.Sc. (Southampton).
Mrs. S. E. Whitehead.

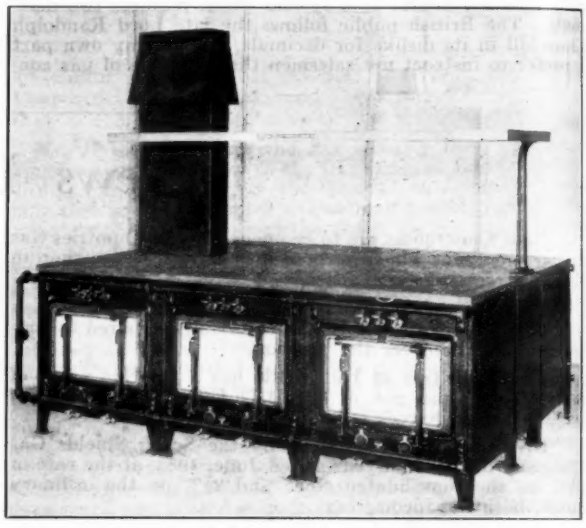
Gas Production in Sweden.

From Mr. G. H. Hultman, the Chief Engineer of the Municipal Gas Department of Stockholm, we learn that despite the ever-increasing competition of electricity, the demand for gas continues to progress, the output of the city's gas-works during 1933 having amounted to roundly 3,313,363,000 c.ft., as compared with 3,266,450,000 c.ft. in the preceding year—an increase of 46,913,000 c.ft., or nearly 1½%.

Steady progress also continues to be made in the use of gas cooking appliances in the Swedish capital, the number of cooking stoves in use having increased during the twelve months from 86,930 to 93,227 and that of the special gas-heated cabinets for keeping food hot from 5,302 to 5,906. A recent development of the Stockholm Gas Department is the introduction of a new type of gas cooking stove; this is made on the muffle principle, the feature being that the combustion gases do not come into contact with the food, the interior of the oven being heated from outside. Although the principle is not new, Mr. Hultman claims that the latest design by the special form of insulation is able to show gas consumption equal to the best of the usual type internal-burner cooking stoves.

To encourage the use of domestic gas-using appliances, the Department has two showrooms in Stockholm, in one of which is a large hall in which lectures and demonstrations are from time to time arranged. Finally we learn from Mr. Hultman that, although no actual trials have so far been carried out, investigations have recently been made as to the possibility of using compressed gas for commercial motor vehicles.

House of Commons Chooses Gas.



Two Central pattern 6-oven "Solidtop" gas ranges, manufactured by Benham & Sons, Ltd., are shortly to be installed at the House of Commons.

In both the ranges, one of which is illustrated above, the flue is located at the end, the main reason being to give a more uninterrupted hotplate cooking area. The ranges will be erected end to end and 5 ft. apart, and the flues will readily adapt themselves for venting into the existing hood. Previously, coal ranges of about equal oven capacity were in use, and the advent of these "Solidtop" ranges will substantially decrease cost of running, repairs, and will make for coolness in the kitchen and greater flexibility for cooking. An existing Bain Marie will be fixed to one end, but it is possible that this will be renewed at a later date. Finish is standard black and ovens are not thermostatically controlled.

At the House of Commons a "Hercules" dish washing machine, also manufactured by Benham & Sons, was installed a year or two ago.

Pensions for Leatherhead Gas Workers.

New Scheme Explained.

What was described by Dr. Laurence Potts as a red-letter day in the history of the Leatherhead Gas and Lighting Company occurred on Aug. 9, when the Company's scheme for providing pensions for the staff and employees was explained.

Two meetings were held, one at the Company's Offices in North Street, and the other at All Saints' Hall. Dr. Potts, Chairman of the Directors, presided, and was supported by Mr. D. F. Irving (Engineer and Manager), and Mr. John Young (Secretary).

Addressing the men, the Chairman said it was the most important meeting which had been held for many years. It was a red-letter day. When he came to Leatherhead in 1880 the Company was a very small concern. Gas was then used for lighting the principal residences and shops. There were not many of the latter. There were about 200 customers in all, and these used the flat-flame burners, and there were no cookers or fires. In the old days there were no slot meters, now there were nearly 4,000, and

about one-third of the gas sold was by this means. The Company grew and the growth of the business had naturally necessitated a considerable increase in the staff and employees. Altogether they had now over 80, and a good many of them had served the Company for many years.

The Directors had long desired to do something to ensure that when an employee grew old he could look forward to reasonable comfort after he ceased to be actively engaged. The Directors recommended all eligible employees to join the Company's scheme, which would be administered in co-operation with the Legal and General Assurance Society.

Company's Share.

Continuing, Dr. Potts stated the employees' contributions alone would not of course entitle them to very great benefits, therefore, the Company was prepared to subscribe a considerable sum per annum in order that the benefits received might be of a substantial nature. The amount payable by the Company was increased by the special call in respect of the older employees in order that they might enjoy equal benefits.

The Chairman mentioned there were three men in the Company's employ over 65 years of age, who were ineligible for the scheme, but when the time came for them to retire the Directors would give their cases careful consideration. One of these men, Mr. F. Currington, storekeeper, had been in the employ of the Company for forty years.

Mr. John Young said, as the oldest official of the Company, he would like to express the pleasure which the Pension Scheme afforded him. By inaugurating the scheme the Directors were conferring very great privileges on their staff and employees. Privileges of a far-reaching nature, which would bring comfort and happiness to all concerned, and doubtless beget a spirit of gratitude which would manifest itself by increased zeal in promoting the Company's welfare.

Thanks to the Chairman for presiding were accorded on the motion of Mr. D. F. Irving.

The Pensions Scheme came into force on Aug. 16, and it is confidently anticipated that all the eligible members of the staff and employees will join. A works employee contributes 1s. 3d. per week and at the age of 65 is entitled to a pension of £1 per annum for each year he has contributed to the scheme, with a minimum of £26 per annum. In addition, until pension age, he is covered by a Life Assurance of £100.

For the staff, the same benefits apply to those members whose salary does not exceed £156 per annum. Between £156 and £250 per annum the weekly contribution is raised to 2s. 6d., the pension to £2, and the insurance policy to £200. Beyond £250 per annum the weekly contribution is raised to 5s., the pension to £4, and the life policy to £300.

Sir Arthur Duckham Memorial Fund.

Official List of Donations from Aug. 4 to Aug. 17.

Name and Town.	Amount. £ s. d.
Woodall-Duckham (Australasia) Proprietary, Ltd.; Directors	16 15 0
Donations (1) paid above	£ 16 15 0
Donations (626) paid previously ...	£10,534 3 8
Total Donations (627) paid...	£10,550 18 8
Donations (2) promised	59 0 0
Total Donations (629) paid or promised...	£10,609 18 8

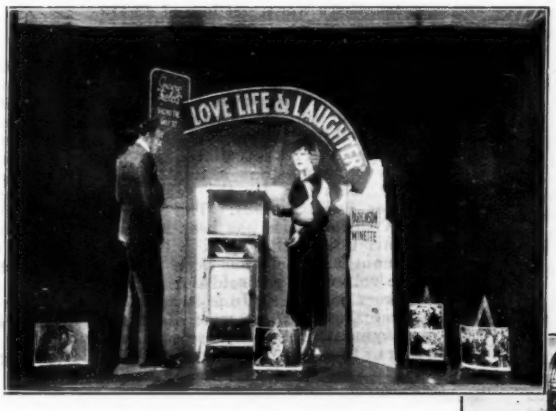
An American Gas Leak Detector.

Development of Stethoscope Principle.

A recent issue of the *Gas Age-Record* gave particulars of an interesting gas leak detector, known as the Gilmore Gas Stethoscope, which has been developed in Topeka, Kansas.

The device is claimed to detect a leak which has set up vibration in the gas within the pipe—a 3 c.ft. per hour leak in a 1-in. pipe being heard over 40 ft. away and a 15 c.ft. per hour leak in a 1¼-in. pipe can be heard 275 ft. away. This relatively inexpensive gas leak detector is said to have been in practical successful use during the past year in some of the large cities in Kansas and Missouri.

The Gas Industry Leads the Way to Love, Life, and Laughter



By co-operation of the Torquay and Paignton Gas Company, displays were arranged in the gas showrooms and the entrance hall of the Burlington Cinema, Torquay, as the illustrations show. The linking of the "Popular Star" with the "Minette" gas cooker was reproduced from the kitchen scene in the film, and gives added proof of the popularity of the "Minette" gas cooker for the modern home.

A special push for gas cooking has been organized by the Parkinson Stove Company by the production and circulation of the attractive window displays illustrated here. These displays are creating considerable public interest, being staged in the gas showrooms, to synchronize with the run of the film "Love, Life, and Laughter" at local cinemas throughout the country.

Amalgamation and Grouping.

Severn Valley and Ludlow.

The Severn Valley Gas Corporation announce that the offer made by them to acquire the whole or any part of the preference and ordinary shares of the Ludlow Union Gas Company, Ltd., has been accepted by a majority of the shareholders.

Public Lighting in Dundee.

An interesting summary of certain facts relating to Dundee's public gas lighting supply has been issued.

There are 152 miles of streets, of which 119 miles are lit by gas and 18 miles by electricity, the remainder being unlit. There are 6,928 gas lamps in public streets and provision is made for more in new housing schemes. In addition there are 975 in back-courts and private gardens, payable by the proprietors.

Gas lamps burned 105 million c.ft. last year. The gas bill was £11,225, against £3,560 paid for electricity. Wages, repairs, &c., in the gas section cost £11,790, mantles to the number of 50,000 being required.

Industrial Accidents.

Much interesting information is contained in the Annual Report of the Chief Inspector of Factories and Workshops for 1933. The improvement in trade conditions in certain industries, while most welcome in providing an increase in the number of workers employed, is unfortunately also responsible for an increase in accidents, the total reported number of which shows an increase from 106,164 to 113,260, while the fatalities have increased from 602 to 688. Probably, however, the rise in the number of accidents is due not wholly to more extensive employment, but also to other and altogether exceptional factors operating at the present time. Workers are returning to employment often after long periods of enforced unemployment. Many of them are suffering from lack of nourishment, and physically and mentally are less alert and more liable to mishap than in normal times. Again, there is evidence that on restarting work after a long spell of idleness some workers tend to over-exert their strength and energy, while others take some time to get accustomed to working conditions again.

While such conditions of liability to accident consequent upon protracted periods of unemployment are, fortunately, not experienced to any great degree in the Gas Industry, the foregoing points are well worth the study of gas executives, for all these factors must be taken into account by the employer in safeguarding workers against mishap. Generally speaking, however, it is true that machinery is more efficiently fenced, plant of all kinds more safely constructed, welfare and working conditions of a much higher standard, and more precautions are taken by employers and workers alike than at any time in our industrial history. Hoists are again responsible for a substantial number of accidents, both fatal and non-fatal, which is the more regrettable since in nearly every case such accidents are preventable by well-known safeguards.

Another point from the report of interest to the Industry is the incidence of epitheliomatous ulceration, which is now the most menacing of all the industrial diseases that are notifiable and shows few signs of diminishing. In 1933 there were 143 cases and 40 deaths, and of these 32 and 1 occurred in patent fuel works, 39 and 2 in tar distilling works, 16 and 9 in gas-works, and 7 and 1 in other pitch and tar industries; 3 cases and 1 death occurred in shale oil works. Without a microscopical examination of the new growths occurring on the skin among workers in contact with the known carcinogenic agents such as pitch, tar, &c., it is impossible to determine whether any or all of them are definitely malignant new growths of the skin. In this connection employers and workers are urged to co-operate more fully in establishing schemes for periodical medical examination.

Accident statistics, however, cannot be claimed always to provide a true index of the dangers in any employment. Not only the number of persons exposed to risk, but the duration of the exposure, must be taken into account, while there are to be considered besides numerous occurrences which are " within an ace of disaster," but actually are unrecorded. Finally there is no standard of severity for non-fatal accidents, and their subsequent history may be affected by a host of circumstances in no way related to the occupation.

Gas Undertakings' Results

Glasgow.

Glasgow Gas Department reports a surplus on the year's operation of £80,038, compared with £75,900 for the previous year. Gross revenue was £1,571,212; gross expenditure £1,260,533; depreciation, written off capital assets, £29,378; balance carried forward to profit and loss account, £281,301; annuities on stock, £16,596; interest on borrowed money, £48,171; and sinking fund, £136,494. Gross expenditure is up by £23,729, and revenue by £13,234. The rate of interest payable to the Corporation Loans Fund was £3 16s. 6d., compared with £4 5s. 1½d. for the preceding year. Sinking fund now stands at £3,327,048, of which there has been applied for the redemption of borrowed money £3,325,911, leaving £1,136 available. Coal carbonized during the year was 549,999 tons, being 1,700 tons more than last year. The average cost of coal carbonized was 16s. 3d., slightly over a penny per ton less than last year. The quantity of coal gas made per ton of coal carbonized was 15,348 c.ft., which, with water gas, gave an average of 15,796 c.ft., compared with 15,474 c.ft. and 15,900 c.ft. respectively per ton for the previous year. The quantity of gas delivered, and accounted for, to the consumers, amounted to 8,708,911,157 c.ft., as compared with 8,661,163,042 c.ft. for the preceding year, an increase of 47,748,115 c.ft. The greatest quantity of gas distributed during the year in 24 hours was 35,893,000 c.ft. The maximum daily make of gas was 36,028,000 c.ft. On May 31 last there were on loan 179,883 cookers and range fittings, 16,155 grills, 49,915 boiling burners, 30,014 gas fires, 5,441 radiators, 1,348 water heating appliances, making a total of 282,716. In addition 50,936 cooking appliances, 50,849 wash boilers, and 60,071 gas fires have been provided and fixed by housing authorities and private builders under Government subsidy.

Kinross.

The Directors' report submitted to the annual general meeting of the shareholders of Kinross and Milnathort Gas Light Company, Ltd., showed that the net profit for the year amounted to £1,099. The Directors recommended a dividend of 7½% per annum, less income-tax. It was decided to reduce the price of gas by 2d. per 1,000 c.ft. to ordinary consumers and by 1½d. per 1,000 c.ft. for industrial use as from the next survey, thus making the new charges: Ordinary, 4s. 7d. per 1,000 c.ft.; industrial, 4s. 8d. per 1,000 c.ft.

Oldbury.

The annual report of the Oldbury Urban District Council Gas Department for the year ended March 31, 1934, shows that there was a gross profit of £8,709, as compared with £7,086 for the previous year. After making provision for capital repayments and interest, there was a net loss of £5,110.

Shrewsbury.

The annual report and statement of accounts of the Shrewsbury Gas Light Company to June 30, 1934, shows that the gross profit on the revenue account amounted to £10,466. After allowing for the interim dividend of 2½%, less tax, paid in March last, and the interest on mortgages for the year, the balance of net profit available amounts to £12,956. The Directors recommend that a final dividend of 4½%, less tax, making 6¾%, less tax, for the year, be now declared, payable on and after Sept. 3, 1934. The reserve fund now stands at £13,802. A suitable site has been acquired for a new gasholder on the district, and this work will be carried out during the next few months. There has been an increase of over 6 million c.ft. in the volume of gas sold during the past year. The number of cookers on hire at June 30 was 5,300, together with 2,177 fires and radiators. There were also 3,288 ordinary meters and 6,802 prepayment meters in use. In addition, the number of gas cookers, fires, water heaters, &c., sold during the year amounted to 940.

Spalding.

The annual report of the Spalding Urban District Council Gas Department for the year ended March 31, 1934, indicates that carbonizing costs are only £9 greater than last year, in spite of the fact that 232 extra tons of coal were carbonized and four million extra cubic feet of gas made, and, compared with two years ago, carbonizing costs show a reduction of £759. The maintenance costs show a reduction of £594 compared with last year. Distribution costs also show a slight reduction, in spite of the large volume of work carried out, but rates show an increase of £92. Interest and sinking fund charges show a reduction of £116. From the sale of gas the revenue totalled £1,000. Income from residuals show a decrease of £220, due to the price of tar having fallen rather heavily during the year, and secondly to the fact that all coke weighed out very light last winter. The gross profit of £6,177 shows an increase of £1,502, the net profit of £1,695 shows an increase of £1,665 over last year.

Irish Association of Gas Managers

ANNUAL GENERAL MEETING IN BELFAST

THE OFFICIAL GROUP AT THE IRISH MEETING, TAKEN IN THE SQUARE OF THE BELFAST CITY HALL.

Pursuing the excellent custom of meeting alternately in the north and the south, this year's meeting of the Association took place on Tuesday of last week in Belfast, and a very good meeting it was, with a first-rate turn-out of members and friends. At the dinner in the evening over 130 sat down, while the excursion on the following day must have been participated in by a party of between 70 and 80.

The business portion of the proceedings was carried out in the handsome showrooms of the Belfast Corporation Gas Department, in Queen Street, and when the meeting was called to order by the President, Mr. J. L. HYSLOP, Chief Assistant at the Belfast Gas-Works, he was supported on the platform by his own Chief, Mr. J. D. Smith, J.P., who was later on present with Mrs. Smith at the dinner, and took part next day in the excursion. The President was also supported on the platform by Alderman A. Hodgen, the Chairman of the Gas Committee, Sir William Turner, D.L., Deputy Lord Mayor of Belfast, Col. W. Moncrieff Carr, Senior Vice-President of the Institution of Gas Engineers (who attended in the unavoidable absence of the President, Mr. C. Valon Bennett), and Mr. George Airth, of Dundalk, the Association's Hon. Secretary and Treasurer. There were also present Mr. E. J. Fottrell, Joint Manager of the National Gas Council of Great Britain and Ireland, and Mr. W. D. Rowe, Manager of the British Commercial Gas Association.

Sir WILLIAM TURNER apologized for the absence of the Mayor, and proceeded to extend a hearty welcome to the members, a duty which he reminded them he had the pleasure of performing under similar circumstances six years ago. He remarked that the Belfast Gas Department was one of the most successful of their civic enterprises, and one of which they were all pardonably proud. Under the skilful and efficient management of Mr. J. D. Smith, it had gone from success to success, and even the industrial depression from which the city had suffered in common with all other cities had been unable to affect its progress. In recent years it had had to meet competition from a developing electrical undertaking, but instead of the output of gas going down it had gone up by leaps and bounds, and from what he had heard the present year was likely to eclipse all previous records.

The PRESIDENT, thanking the Deputy Lord Mayor for his welcome, said Sir William was held in such high esteem that he had filled the office of Lord Mayor for six years in succession. He had at all times taken the greatest possible interest in the welfare of the Gas Department. Continuing, he offered a hearty welcome to the visitors, and particularly to Col. Carr. It was, he said, a great pleasure to know that the Parent Institution continued to take a keen interest in the doings of the Irish Association.

Col. CARR said he was sorry that Mr. Valon Bennett, the President, was unable to be with them, as he knew that he had been very anxious to attend. Mr. Hyslop was right in remarking that the parent body took an interest in the doings of the District Associations. In fact, of late years the Council of the Institution had been seeking every possible means of strengthening the bonds between the Institution and the District Associations. The more the work could be co-ordinated, the better it would be. They had seen much in the Technical Press during the past twelve months about having one national body, as the result of some inspiration derived by those of them who went to America last autumn and became somewhat envious of the American Gas Association. Well, some way had been gone in this direction by the appointment of a Co-ordinating Committee between the three national bodies, and he hoped that this Committee was going to serve an enormously useful purpose. With a fair field, the Gas Industry was bound to go on from strength to strength, because it could provide heat in its cheapest form. It had been a great encouragement to him during the visit to Canada and the United States to note the great prosperity of the Gas Industry in face of keen competition by huge hydro-electric schemes.

The PRESIDENT asked Col. Carr to convey the good wishes of the Association to the President and Council of the Institution. They hoped to have the pleasure of seeing Col. Carr with them again next year as President of the Institution.

The Presidential Address.

Mr. HYSLOP then delivered his Presidential Address, which will be found on pp. 363-365 of last week's "JOURNAL."

Mr. L. G. YOUNG (Carlow), at its conclusion, proposed a hearty vote of thanks to the President, and in the absence of Mr. F. J. Edmonds, of Waterford, the Immediate Past-President, bestowed upon Mr. Hyslop the President's Medal. He trusted the President might be long spared to wear it.

The vote of thanks was seconded by Mr. W. E. YOUNG (Queenstown), and acknowledged by Mr. HYSLOP.

Col. CARR said the address had been a real treat. As a considered and well-prepared synopsis of the position to-day, it would be appreciated by the whole of the Gas Industry.

Committee's Report and Accounts.

Mr. AIRTH then read the following report of the Committee:

It is with pleasure that your Committee records the great success of the meeting held in Waterford on Aug. 15, 1933.

Owing to the long journey south, the attendance of members was slightly less than when the meetings are held in Dublin, but all who attended took great interest in the excellent papers provided. We again had the pleasure of having the President of the Institution of Gas Engineers (Mr. F. P. Tarratt) with us. He took a deep interest in our deliberations, and spoke admirably on all the papers. The members and their lady friends were entertained at luncheon by Alderman F. J. Edmonds, the President, and Mrs. Edmonds, after which a visit was made to the gas-works, where a photograph was taken. In the evening, the City of Waterford Gas Company invited the members and lady friends to a dinner in the Town Hall, where they were welcomed by Sir Stanley Harrington, Deputy-Chairman of the Company. Dinner, speechmaking, and concert being over, dancing was indulged in until the early hours of the morning, an innovation at our meeting which was greatly enjoyed.

An enlargement of the group portrait, taken at the gas-works, was sent to the Chairman and Directors of the Company, as a token of our grateful thanks to them for having so lavishly entertained us during the conference.

For the first time in many years no excursion could be arranged, as the Tramore Races taking place on the same day made it impossible to get motor buses. The Committee are very sorry that our old-established reunion on the second day had to be abandoned, and hope this will not occur again.

Your Secretary and Committee have been in communication with the Local Appointments Commissioners *re* appointment of managers to gas-works in the Free State, and have been informed that consideration will be given to all their future communications.

The attention of the Minister of the Department of Industry and Commerce (Irish Free State) was drawn to the fact that a subsidy of 2s. 6d. per ton (50% of the Coal Duty) was being allowed in respect of coal imported into the smaller ports. The Minister was asked to extend this subsidy to gas-works, as public utility concerns, but replied that he was not prepared to authorize the free entry of coal for gas-making purposes. Since then, concession has been made to the Great Southern Railway Company for free entry of British coals for firing purposes. The Irish Free State intend, shortly, to introduce in the Dail a Free State Government Coal Bill, which will require every importer of coal in the Free State to hold a licence for so doing. This will have to be seriously viewed, and the Committee suggest that your Secretary and the Secretary of the Irish District Executive Board of the National Gas Council of Great Britain and Ireland should be appointed to look after your interests in this matter.

It is also recommended by the Committee for your adoption that in future the Secretary of the National Gas Council of Great Britain and Ireland (Irish District Executive Board) be invited to all Committee meetings, so as to keep the two Associations in touch with each other's workings.

The balance to credit in the Treasurer's hands this year is £153 6s. 8d., as compared with £137 5s. 10d. in the preceding year.

Mr. L. P. PHILLIPS (Dublin), the Auditor, summarized the balance-sheet, which showed a balance in the bank of £153 6s. 8d. This, he remarked, was very satisfactory.

The report and accounts were adopted without discussion, on the proposition of Mr. G. WALMSLEY (Londonderry), seconded by Captain G. ANDERSON (Kilkenny).

A hearty vote of thanks was accorded Mr. Airth and Mr. Phillips for their indefatigable work on behalf of the Association.

The PRESIDENT said it was his desire to thank Mr. Airth personally for the great help he had given him during the past year. No trouble that Mr. Airth could take was too great, so long as he felt it was going to assist the Association or the President. This was his 26th year as Secretary, and they all hoped he might be long spared to carry on the good work.

Mr. AIRTH, in responding, remarked that in two years' time the Association would be celebrating its 50 years, and he hoped that by then they would have looked round for a younger and more progressive Secretary than himself.

Office-Bearers and New Members.

Messrs. J. Oxley (London) and H. Saville (Leeds) were appointed Scrutineers of the ballot papers, and subsequently reported the following elections:

President.—J. A. Rooney, Drogheda.

Vice-President.—P. J. M'Evoy, Midleton, Co. Cork.

Members of Committee.—C. W. Surman, Ballymena, J. A. Pemberton, Sligo, and L. W. Dalby, Kilkenny.

District Representative on Council of Institution of Gas Engineers.—J. A. Rooney, Drogheda.

Auditor.—L. P. Phillips, Dublin.

Hon. Secretary and Treasurer.—G. Airth, Dundalk.

As Ordinary Members.—H. C. Harrison, Belfast, F. J. Boyd, Belfast, and W. A. Campbell, Belfast.

As Extraordinary Members.—F. J. Siddall, Manchester, H. S. Cheetham, London, C. R. Averill, London, R. J. Rogers, Birmingham, and G. H. Elliott, Sheffield.

Report of the District Representative on the Council of the Institution of Gas Engineers.

Mr. AIRTH then read the following report by the President, Mr. Hyslop, in his capacity as District Representative of the Association on the Council of the Institution of Gas Engineers, and it was adopted, on the proposition of Mr. B. MITCHELL (Bangor), seconded by Mr. J. A. ROONEY (Drogheda).

As District Representative of the Association upon the Council of the Institution of Gas Engineers, I have during the past year attended one of the meetings of the Council in London, where I met with a cordial reception. Of the matters which have come up for consideration at the various meetings none has had any direct bearing upon the interests of our Association, but many questions have been discussed which concern the future progress of the Industry, and as such are of interest to us.

These matters, as a rule, have eventually been reported in the Technical Press, so there is no need for me to go into details. Among the questions which have been dealt with are insurance of boilers, precautions to be taken during the repair of gasholders, rating and standardization of meters, and the development of industrial gas.

The Committees responsible for the various branches of research have continued to carry out valuable work, and the reports submitted at the Research Meeting of the Institution in November last provided valuable information on various aspects of the problems that confront us. The Education Scheme of the Institution continues to be well supported, and it is pleasing to note, from the numbers who continue to present themselves for examination, that the enthusiasm of the younger members for the scheme has not in any way abated. The percentage of successes recorded is very satisfactory, and augurs well for the future.

Papers Read.

Three papers, bearing the titles indicated below, were next read. It was decided, in order to economize time, that the discussion should be taken as a whole when all the papers had been submitted, but for ease of reference in the "JOURNAL" the remarks have been divided out and are in each case placed at the end of the paper to which they particularly refer.

Mr. J. H. ALLEN, F.S.I. (Belfast and Dublin), "Valuations." [To be published next week.]

Mr. C. W. SURMAN (Ballymena), "Reconstruction of a Small Gas-Works." [See p. 417.]

Mr. T. TALLENTIRE (Lurgan), "Modernizing of a Street Lighting Installation." [See p. 420.]

On the proposition of the PRESIDENT, the authors were heartily thanked for their contributions.

Mr. ROONEY returned thanks for his election as President, and said his Committee at Drogheda would greatly appreciate the honour that had been done him.

IRISH DISTRICT EXECUTIVE BOARD OF THE NATIONAL GAS COUNCIL.

In the afternoon there was held at the Queen Street Showrooms the thirteenth annual meeting of the Irish District Executive Board of the N.G.C., the chair being taken by Mr. J. D. SMITH.

In the absence of the Hon. Secretary (Mr. F. J. Edmonds), Mr. E. J. Fottrell acted as Secretary of the meeting.

The minutes of the meeting held in Waterford on Tuesday, Aug. 15, 1933, were taken as read and signed.

It was reported that no change had taken place in the list of members of the Board, and the list was taken as read.

Mr. J. D. Smith was unanimously re-elected Chairman of the Board for the ensuing year; and, on the motion of the Chairman, Messrs. W. J. Grey (Dublin) and J. Ronan (Cobh) were unanimously re-elected Vice-Chairmen. The following were elected members of the Management Committee: Messrs. G. Airth, R. B. Anderson, W. J. Grey, A. Law, J. M'Nicholl, B. Mitchell, J. A. Rooney, J. D. Smith, G. Walmesley, W. M. Pettigrew, and A. S. Brook.

Mr. F. J. Edmonds (Waterford) and Mr. A. S. Brook (Lisburn) were appointed Joint Hon. Secretaries.

At the conclusion of the formal business,

Mr. E. J. FOTTRELL (Joint Manager of the National Gas Council) reminded those present that this was an era of experts, and that no engineer or manager of a gas undertaking could be expected to be fully conversant with the

numerous problems of law, finance, and administration with which he was from time to time called upon to deal. Those authorities upon whose interests the activities of gas undertakings were likely to impinge were ably advised by their respective associations, and it was incumbent upon gas undertakings, large and small, to ensure that their legitimate aims were in turn safeguarded by joining the National Associations of the Gas Industry. The subscription asked was negligible in comparison with the advantages accruing from membership and with the risk involved in remaining isolated from the work of the national bodies.

Mr. W. D. Rowe (Manager of the British Commercial Gas Association) expressed his pleasure at meeting, for the first time, the members of the Association, and went on to describe the activities of the B.C.G.A. He referred to the background of national and district advertising done by the Association and to the advertisements which appeared in important magazines and in trade papers. These advertisements were of tremendous value to the whole Gas Industry, appealing, as they did, not only to the public, but to those in authority. He then dealt with the Association's policy with regard to the publication of literature, and urged all members to support such publications by increased orders. He alluded to the staff education courses arranged by the Association, and appealed to members to see that their staffs were well trained on the commercial side. It was hoped that some arrangement would be made for the fitters' course to be altered to meet the needs of scattered districts in Ireland. Turning to the matter of display in showrooms and windows, Mr. Rowe announced the appointment of Mr. W. R. Oliver as Display Officer of the Association. Mr. Oliver, who had had a long and varied experience of display work, would be at the disposal of members, and would give them the benefit of his expert advice. The appointment of Mrs. Murphy to conduct a home service section of the B.C.G.A. was also announced, and it was pointed out that Mrs. Murphy would visit districts in turn and give them the benefit of her experience. Other matters, such as domestic inquiries and district conferences, were mentioned, and Mr. Rowe subsequently replied to various points raised by members in an open discussion.

A vote of thanks to Mr. Fottrell and Mr. Rowe was proposed by Mr. M'Nicholl, and seconded by Mr. Young.

The meeting concluded with a vote of thanks to the Chairman.

ANNUAL DINNER.

Members and friends, to the number of about 130, assembled again in the evening in the Grand Central Hotel, where the annual dinner took place, with the President in the chair. He was supported by the High Sheriff (Alderman Dr. J. D. Williamson, D.L.), Councillor Albert Hodgen (the Chairman of the Gas Committee), and Mr. J. D. Smith. The dinner itself calls for a word of special praise, as do the contributions to the musical programme by Miss Ruth O. George, Mr. S. W. McCormick, Mr. George Hatch, and Mr. W. Magill. The Loyal Toast having been honoured at the call of the President,

Mr. A. S. Brook (Lisburn) submitted "The City and Trade of Belfast," and this was responded to by the High Sheriff, who cordially congratulated Mr. Hyslop upon the very successful way in which he had presided over the meeting, and for the very able address he had delivered. The gas supply of Belfast had progressed with the city. To-day the lighting of the city was second to none in the United Kingdom. Mr. Smith, as Gas Engineer, had maintained the reputation of the city in an extraordinary degree, and he was assisted by a most capable staff.

An Enterprising Association.

Mr. J. D. Smith, proposing the toast of "The Gas Industry and Kindred Associations," remarked that they had all had the experience at one time or another of hearing some misinformed person suggest that the Gas Industry was old-fashioned. There might have been a grain of truth in the statement at one time, but it certainly did not apply to the Gas Industry of to-day. Old in years it might be, but it had all the energy, the optimism, and the enthusiasm of youth. For many years now it had taken full advantage of every advance of scientific knowledge, and had applied it to its needs. It had organized and had carried out, through the Institution of Gas Engineers, an extensive research programme of its own, and had brought both the manufacture and the utilization of gas to a high state of efficiency. Schemes for training the younger members of the profession had been developed, and steps had been taken to ensure a very high standard of technical accomplishment in the rising generation. The Industry, as a result, was one of the most progressive in the country to-day, better equipped in material and in personnel than at any previous period in its long history. As an industry they were very well served by their national bodies.

How to Deal with the Smoke Problem.

The first of the four responses to the toast was by Col. Carr who said that if he had gathered one impression more than another of their Association it was an impression of enterprise. This enterprise was indicated by the magnificent address by the President, and by the excellent communications submitted to the meeting. They need have no fear as to the future so long as they saw the younger members of their Associations coming forward with progressive ideas and valuable suggestions. In fact, they must all have a most profound belief in the Industry which they served. They had a very big function yet to fill, for the real answer to the smoke problem was gas.

Their health experts would, as time went on, devote more and more of their efforts to the cleansing of the atmosphere, and the means to do so was already in their hands. He hoped that the time would come when the burning of raw coal would be prohibited, and then the Gas Industry would come into its own. He felt they could not tell the public too much about the services gas manufacturers could render them, and he believed that in time the public, just as they detested dirt in their food and in the water they drank, would come equally to detest dirt in the atmosphere they breathed.

The Industry was now empowered to make contracts and on an optional basis offer special facilities, and in this way he felt there were great opportunities for their heating business. He had therefore been particularly pleased to learn that morning that Ballymena was selling gas for heating at a substantially lower rate than for lighting. This was the way for the Gas Industry to deal with the smoke problem.

Mr. E. J. Fottrell said that since he last addressed them a move had been made in the direction of unified effort. In these days of competition there was naturally a tendency for the different organizations to overlap, and in the Joint Co-ordinating Committee they had endeavoured to consolidate the work of the kindred Associations who had already done so much for the Industry.

Mr. W. D. Rowe said it had been a great pleasure to him to pay his first official visit to Ireland. It was never more necessary than to-day that they should all pull together. It was the job of the B.C.G.A. as a national body to "tell the world," and this they intended to go on doing.

Mr. Frank West, representing the Society of British Gas Industries, said he felt this a great opportunity to say a few words for some of the former colleagues of the President. On their behalf, he heartily congratulated Mr. Hyslop on the honourable office he occupied. In his own Society the members were doing all they could to co-operate with the other Associations in forwarding the interests of the Gas Industry.

Mr. J. M'Nicholl toasted the President, and in reply Mr. Hyslop explained that it was with West's Gas Improvement Company he started his career, and he had never forgotten the grounding he got there. He thanked his Chief, Mr. J. D. Smith, and his colleagues, for the help they had given him in making the meeting a success.

"The Belfast Gas Department" was submitted by Mr. H. W. Saville, who said it was a fortunate thing that there were many public-spirited men who were willing to act as trustees of a great gas undertaking like that of the City of Belfast. Without fee or reward, such men would, for the good of their fellow citizens, give of their time and experience to public work of this important character.

Councillor Albert Hodgen, replying, expressed his pleasure at being at the dinner, because, as Chairman of the Belfast Corporation Gas Committee, he welcomed the opportunity of meeting those connected with other gas undertakings in Ireland. Thanks to the skilled management of Mr. Smith over a great number of years, the Belfast gas undertaking was one of the most prosperous in the country.

The Committee also fully appreciated the services as Chief Assistant of Mr. Hyslop. He knew his job, and the Committee believed he had a great future before him.

The remaining toasts were "The Ladies," submitted by Col. Glover and responded to by Mrs. Hyslop and Mr. Rowe; and "The Press," proposed by Mr. J. A. Rooney, and replied to by Mr. Alfred Harrison.

Outing and Golf Competition.

On the following day many members proceeded to Portrush, where there was much to make the day memorable, though the weather was not all the time of the best. After luncheon in the café of the London, Midland, and Scottish Railway Company, some of the party proceeded by special omnibus to the Giant's Causeway, while others admired the many beauties of this delightful seaside town.

Yet others carried into effect their intention to take part in the annual golfing competition. This was held on the Portrush Golf Course; a start being made in wretched weather, which, however, gave place to fine conditions later on. There were 24 competitors, and the play afforded much interest. In the event, the winner of the Grant Cup was Mr. F. G. McElwee. In a stroke competition, the following result was announced: Best gross, Mr. C. R. Averill; first, Mr. D. H. Munro; second, Mr. A. Law; third, Mr. A. Robin. A ladies' putting competition resulted: First, Miss Dunlop; second, Mrs. Rooney; third, Mrs. T. D. Hamilton. Mrs. Hyslop kindly presented the prizes.

In early evening the parties met once again at the railway station, to find that the ever-thoughtful Secretary had arranged for a meat tea to be served on the train during the journey back to Belfast. Thus were an enjoyable day and a successful meeting brought to a close.

Standard Specifications for Refractory Materials for Gas-Works

During the year 1933-34 the Refractory Materials Joint Sub-Committee of the Institution of Gas Engineers and the Society of British Gas Industries, together with representatives of the British Refractories Research Association, reconsidered the Standard Specifications for Refractory Materials for Gas-Works. The result of their deliberations is embodied in the revised Specifications published below by permission of the Institution of Gas Engineers. The revision cancels all previous Specifications.

SECTION I.

SILICA AND SILICEOUS BRICKS, BLOCKS, TILES, &c.

Definition.

The material covered by this specification is divided into two classes:

(1) That containing 92% and upwards of silica, and hereinafter called "silica" material.
(2) That containing more than 78 but not more than 92% of silica, and hereinafter called "siliceous material."

Refractoriness Safety Test.

Test-pieces of the material shall show no "signs of fusion" when prepared and heated in a suitable furnace, according to the method described in Appendix I., to:

(*a*) not less than Seger cone 30 (about 1,670° C.) for silica material.
(*b*) not less than Seger cone 29 (about 1,650° C.) for siliceous material.

Chemical Analysis.

A complete chemical analysis of the material is to be provided when called for by the purchaser for his personal information only.

Surfaces and Texture.

The material shall be evenly burnt throughout, and of regular texture. All surfaces shall be reasonably true.

After-Contraction or Expansion.

Silica Material:

Test-pieces when prepared, heated to 1,450° C. and maintained at that average temperature for two hours, in accordance with the method described in Appendix II., shall not show an after-expansion of more than 0·5%, a tolerance of 0·1 being allowed for experimental error.

Siliceous Material:

Test-pieces when prepared, heated to 1,410° C. and maintained at that average temperature for two hours, in accordance with the method described in Appendix II., shall not show an after-expansion or contraction of more than 0·5%, a tolerance of 0·1 being allowed for experimental error.

Variation from Specified Dimensions.

In the case of all bricks, blocks, and tiles, there shall not be more than 1¼% variation in length, width, or thickness from specified dimensions, except for dimensions of 3 in. or less where the permissible variation may be ± $\frac{1}{8}$ in.

Jointing Material.

The jointing material shall be quite suitable for use with the bricks, blocks, or tiles for which it is supplied.

Inspection and Testing.

Samples representative of the bulk may be selected for the purpose of testing either before or after delivery; but a representative of the maker and of the user shall, if they choose, be present when such selection is made, and shall be supplied with pieces of the samples taken for the purpose of testing.

Any complaint as to quality of material shall be made by the purchaser before the expiration of ten days after delivery.

If the purchaser and the maker are not in agreement upon the results of each other's tests, they shall submit the samples for testing to an independent authority to be mutually agreed upon. The purchaser reserves to himself the right, if the material does not conform to the tests laid down in the specification, to reject any or all the material in the consignment from which the test-pieces were taken. No consignment shall be rejected on the results obtained from a single sample (because of the possibility of "freaks").

The cost of these independent tests and of any bricks, blocks, or tiles, damaged before delivery for obtaining test-pieces, shall be borne by the purchaser if the test proves satisfactory; and, if unsatisfactory, such cost, and that for all other subsequent tests required on this account from the same consignment, shall be borne by the makers.

The cost of any test or of any material damaged for the purpose of obtaining test-pieces after delivery shall be borne by the purchaser in the event of the test being satisfactory, and, if unsatisfactory, by the manufacturer, in a similar manner to that specified for the tests prior to delivery.

[The inspection and testing clauses are similar for Section II. and Section III.]

SECTION II.

FIREBRICKS, BLOCKS, TILES, &c.

Definition.

For the purposes of classification it is understood that this specification applies generally to goods made from fireclay and containing not more than 78% silica.

Refractoriness Safety Test.

Two grades of material are covered by the specification, to be called respectively No. 1 and No. 2 Grades.

Test-pieces of the material shall show no "signs of fusion" when prepared and heated in a suitable furnace, according to the method described in Appendix I., to:

(*a*) not less than Seger cone 29 (about 1,650° C.) for No. 1 Grade.
(*b*) not less than Seger cone 26 (about 1,580° C.) for No. 2 Grade.

(N.B.—Firebricks, which pass the refractoriness safety test at cone 32, belong to the class of "Special Refractory Materials.")

Chemical Analysis.

A complete chemical analysis of the material is to be provided when called for by purchaser, for his personal information only.

Surfaces and Texture.

The material shall be evenly burnt throughout, and of regular texture. All surfaces shall be reasonably true.

After-Contraction or Expansion.

Test-pieces, when prepared, heated to 1,410° C. and maintained at that average temperature for two hours, in accordance with the method described in Appendix II., shall not show an after-contraction or expansion of more than:

(*a*) 0·75% for No. 1 Grade material,
(*b*) 1·15% for No. 2 Grade material,

a tolerance of 0·1 being allowed for experimental error.

Variation from Specified Dimensions.

In the case of ordinary bricks, 9 in. by 4½ in. by 3 in. or 2½ in. thick, there shall not be more than ± 1¼% variation in length and $^{+1\frac{1}{4}}_{-2\frac{1}{2}}$% variation in width and ± 2% variation in thickness.

In the case of special bricks, blocks, or tiles, there shall not be more than ± 2% variation from any specified dimensions.

Jointing Material.

The jointing material shall be quite suitable for use with the bricks, blocks, or tiles for which it is supplied.

Cold Crushing Strength.

The material shall be capable of withstanding a cold crushing stress of not less than 1,800 lbs. per sq. in., when applied in the manner set out in Appendix III.

Marking of Material.

All bricks, blocks, or tiles shall be distinctly marked to indicate the grade to which they belong.

SECTION III.

MOULDED FIRECLAY AND SILICEOUS RETORTS.

Definition.

The moulded retort is defined as a complete section of a retort without longitudinal joints, manufactured from any fireclay or siliceous material. (N.B.—Retorts in segmental form shall come within the specifications for silica, siliceous, or fireclay bricks, blocks, or tiles in Sections I. and II.)

Refractoriness Safety Test.

Test-pieces of the material shall show no "signs of fusion" when prepared and heated in a suitable furnace, according to the method described in Appendix I., to not less than Seger cone 28 (about 1,630°).

Chemical Analysis.

A complete chemical analysis of the material is to be provided, when required by the purchaser, for his personal information only.

Surfaces and Texture.

All the surfaces shall be reasonably true; and, after burning, no "washing" shall be done without the consent of the pur-

chaser. The material shall be evenly burnt throughout and of regular texture.

AFTER-CONTRACTION OR EXPANSION.

Test-pieces, when prepared, heated to 1,410° C. and maintained at that average temperature for two hours, in accordance with the method described in Appendix II., shall not show an after-contraction or expansion of more than 0·75%, a tolerance of 0·1 being allowed for experimental error.

VARIATION IN DIMENSIONS.

Moulded retorts shall be true to template in cross-section, longitudinally straight, of even bore throughout their length, uniform in thickness, and not warped or twisted. The permissible variation from the straight shall not exceed $\frac{3}{4}$ in. in 7 ft. of length, and in cross-section not more than $\pm \frac{1}{4}$ in. in any dimension.

SECTION IV.

SPECIAL REFRACTORY MATERIALS.

At present it is not considered advisable to draw up specifications for a class of special refractory materials, including products manufactured from chromite, sillimanite, and from corundum, carborundum, or other electrically-fused materials. Firebricks which pass the refractoriness safety test at cone 32 are, also, considered to belong to this class.

It is suggested, however, that the clause which details the variations from measurement allowed for silica products should also apply to this group of products.

APPENDIX I.

REFRACTORINESS SAFETY TEST.

The test-piece cut from the body of the brick or block and not including any of the original face, is ground in the dry state, on a suitable wheel such as one of carborundum or emery, to the shape of a pyramid with a triangular base, with one edge perpendicular to the base, and of the following dimensions:

Sides of triangular base, $\frac{3}{4}$ in.
Height of test-piece, $1\frac{1}{2}$ in.

A tolerance of $\frac{1}{16}$ in. may be allowed in these dimensions, but when the base is larger (within the tolerance) the height must be correspondingly larger (within the tolerance) than $1\frac{1}{2}$ in. and *vice versa*, since the shape and the size of the test-piece are extremely important.

The test-piece is cemented on a refractory disc with a refractory cement (consisting of calcined alumina and 10% of best china clay), with the perpendicular edge vertical. This last condition is very important. Five Seger cones, comprising the specified cone and those immediately above and below, are placed at regular intervals round the test-piece and equidistant from it. Care should be taken that the perpendicular edges of the cones are placed vertically.

The test-piece with the surrounding Seger cones is placed in a suitable furnace and the temperature raised at the rate of 50° C. per 5 minutes after about 1,000° C. has been reached. The test must be carried out in an atmosphere containing free oxygen. When the specified cone has bent tip to base the test-piece is immediately removed from the hot zone and afterwards examined for signs of fusion. The signs adopted are either (1) the angular edges of the test-piece beginning to lose their angularity, or (2) the test-piece showing signs of bending, or (3) the matrix running out. The bending, if doubtful, can be judged by the use of a straight edge on the original vertical edge.

If a gas-heated furnace is used, direct flame contact with the test-piece and cones must be avoided, and if an electric furnace is used local "hot spots" must be avoided.

It is contemplated that the standard test should be made on only one test-piece at a time, when carried out in a vertical tube furnace. Should more than one test-piece be placed in the furnace for experimental purposes, care should be taken that the temperature is uniform over all the test-pieces.

The above test shows whether the material begins to soften at the specified cone and should not be confused with the well-known test for refractoriness, which gives the squatting point of the material.

APPENDIX II.

AFTER-CONTRACTION OR EXPANSION.

Two test-pieces, $2\frac{1}{2}$ in. to 3 in. in length and $1\frac{1}{2}$ in. to 2 in. in width and in breadth—representative of the whole piece of material—are cut out. The opposite ends are ground parallel on a suitable wheel such as one of carborundum or emery and the length measured by means of a gauge to 0·002 in. or 0·005 cm. It is necessary to outline the position of the callipers at the initial measurement with a suitable refractory marking mixture in order that the test-piece may be measured at the same position after firing. The test-pieces should be supported, vertically, in the furnace on some granular refractory material such as carborundum to prevent "sticking." A suitable gas-fired furnace with blast if necessary is used to fire the pieces. The test should be conducted in an atmosphere containing free oxygen.

To ensure the test-pieces being uniformly heated throughout and to avoid the formation of cracks in the case of silica material, at least four hours should be taken to attain the final soaking temperature. The furnace is maintained at this temperature for two hours. The average soaking temperature is (*a*) 1,450° C. for silica material, and (*b*) 1,410° C. for siliceous material, firebricks, blocks, tiles, and retort materials; the temperature during the early stages of the firing should be raised very slowly. Temperature readings should be taken every fifteen minutes, and it is essential that, when the final temperature has been reached, it shall be maintained practically constant, *i.e.*, it shall not vary more than ± 20° C. If it is necessary to remove plugs, &c., for the purpose of measuring temperature, great care must be taken to avoid cooling the furnace.

When the test-piece is cold, the length is again measured and the percentage alteration in size calculated. The average of the two results constitutes the "after-contraction or expansion."

When one test-piece is cut from an end and the other from the middle of the sample, some difference in the two results may be noted. It may be desirable then to report both results and not the average.

APPENDIX III.

COLD CRUSHING STRENGTH.

The machine required for the measurement of the crushing strength is so expensive that it will generally be necessary to

APPENDIX V.

SPECIFICATION SUMMARY.

A Summary of the limitations laid down in the Standard Specifications for Refractory Materials for Gas Works.

—	Bricks, Blocks, Tiles, &c.				Moulded Retorts.
	Silica Material.	Siliceous Material.	Firebrick Grade 1.	Firebrick Grade 2.	
Composition; Silica Content.	Minimum, 92 per cent.	92 to > 78 per cent.	Maximum, 78 per cent.		
Refractoriness Safety Test. No signs of fusion at	Cone 30.	Cone 29.	Cone 29.	Cone 26.	Cone 28.
After-Expansion; 2 hrs. at 1450° C.	Maximum,* 0·50 per cent.				
After-Expansion or Contraction; 2 hrs. at 1410° C.		Maximum,* 0·50 per cent.	Maximum,* 0·75 per cent.	Maximum,* 1·15 per cent.	Maximum,* 0·75 per cent.
Variations from Specified Dimensions.	± 1½ per cent. for dimensions above 3 inches. ± $\frac{1}{16}$ inch for dimensions less than 3 inches.		For ordinary bricks ± 1½ per cent. in length, $+1\frac{1}{2}$ $-2\frac{1}{2}$ per cent. in width, and ± 2 per cent. in thickness. For specials, blocks and tiles, ± 2 per cent. maximum for all dimensions.		¾ inch variation from the straight in 7 feet of length. ± ¼ inch in cross section.
Crushing strength, lbs./sq. inch.			Minimum, 1,800.		

* A tolerance of 0·1 per cent. is allowed for experimental error.

have the tests carried out in a suitably equipped laboratory. The method to be employed is often determined by the capacity of the machine. The measurements on which the datum stated in the specification was based were made in a large Avery machine with whole bricks placed with their long side vertical between the jaws of the machine, giving a vertical thrust. The most important factors requiring attention are:

(1) The two ends of the brick which come in contact with the jaws of the machine must be ground flat and parallel, on a suitable wheel, so as to receive a vertical thrust.

(2) An average of not less than three bricks must be used, because flaws, &c., may give an abnormal result, which might not be detected if only one brick were tested.

APPENDIX IV.

INSPECTION AND TESTING.

It has been pointed out by the representatives of the manufacturers that, owing to the high cost of carriage, they may be involved in serious loss if material is extensively rejected after delivery. They agree that the purchaser must have entire freedom to test, and reject, if necessary, any unsatisfactory material delivered to him; but it is suggested that it may be possible to render the manufacturer some assistance by allowing a fairly large sample of his material to be sent in for testing and general approval before extensive deliveries are made. This is in no way, however, to be construed as removing the right of the purchaser to test material in any subsequent consignment.

Distribution of Bottled Gas

A. Pignot, in *Journal des Usines à Gaz*, 1934, 58, 365-372 (July 20), discusses various aspects of the transport of bottled gas to localities not served by the distribution network.

It is arguable whether distribution of bottled gas should be undertaken by the gas company or by a separate organization. In the latter case, the gas company would have dealings with but one important client, and this is an advantage.

The cost of installation of the necessary equipment for a small consumer is as follows:

[Here and subsequently, francs have been converted at par of exchange.]

	£	s.	d.
Three cylinders of ordinary steel (water capacity of each = 1·65 c.ft.) at 48s.	7	4	0
Reducing valve—governor	1	14	0
Sheet iron cupboard	0	19	0
Safety valve	0	2	0
Installation costs	0	5	0
	£10	4	0

A good method of renewing cylinders is by the use of gas-driven lorries. Fifteen lorries have been equipped by the Paris Gas Company for the transport of bottled gas to consumers. With a suitably designed system of racks, the transport work can be undertaken by one man. The cylinders should be situated at such a height in the lorry that they can easily be lifted on to his shoulder. If 45 cylinders are arranged on the lorry, in three horizontal rows of 15, the axis of the top row of cylinders will only be 20 in. from that of the lowest row. The total weight of 45 steel cylinders would be about 3½ tons.

It is contemplated that the lorry would make one round per day in a period of 8 hours. This would represent an average of 11 minutes per cylinder for the journey and for fitting up the cylinder and collecting the empty cylinder from a consumer.

The cylinders, used for the storage of the gas used as fuel by the lorries, are best fixed to the chassis itself so that the maximum space is available for the carriage of cylinders for delivery.

It is assumed that each journey will cover 50 miles so that deliveries can be made within a radius of 25 miles from the compression station. The tar consumed by a 5-ton lorry will be about 28 c.ft. per mile, hence 1,400 c.ft. of gas are required per journey and the lorry must be fitted with 4 cylinders charged to 200 atmospheres or 6 cylinders charged to 150 atmospheres. These, with their fittings weigh about 0·5 ton, hence nearly 1 ton can be devoted to the racks on which the 45 new cylinders are carried.

If it is assumed that the cylinders are charged to a pressure of 175 atmospheres for distribution and that a lorry makes 312 journeys per annum, the annual quantity of gas transported will be approximately 4·05 million c.ft. per lorry. The annual fuel gas consumption of a lorry is 437,000 c.ft. The cost of this gas is taken to be 2s. 1d. per 1,000 c.ft. at the holder *plus* 8·5d. per 1,000 c.ft. for compression. The cost of the fuel gas is thus £61 per lorry per annum.

The following information is given:

			£
Cost of lorry, completely fitted	£525	Annual expenses if lorry and driver are employed solely for the distribution of bottled gas—	
Annual mileage = 312 × 50	= 15,600	Amortization of vehicle	63
Amortization in 8 years—		Tyres, repairs, and oil	19
Exchange value after 8 years	= £21	Insurance	14
Tyres	£7 per annum	Tax	14
Repairs	£9 per annum	Fuel gas	61
Driver's wages	£140 per annum	Driver	140
		Total	£311

The transport cost of £311 for 4·05 million c.ft. of gas represents approximately 1s. 6d. per 1,000 c.ft. This is a minimum figure since the lorry is assumed to dispose of all its load on each working day of the year.

The costs of compression are dissected as follows:

It is assumed that two lorries are in use. These would distribute 90 cylinders per day or 26,000 c.ft. of gas. Hence, 90 cylinders and the lorry cylinders would have to be charged each night, say, between 5 p.m. and 7 a.m. A compressor with a capacity of 2,450 c.ft. of gas per hour would compress the carried gas in 10½ hours and the additional 2,800 c.ft. of fuel gas in 1 hour 10 minutes. It is assumed that there would be a stand-by compressor and that each compressor would have its own motor.

—	Capital Cost.	Amortization Period.	Annual Cost.
	£		£
Two compressors	590	10 years	59
Two 32 H.P. motors with accessories	180	20 ,,	9
Buildings and foundations	240	30 ,,	8
Mains, pipes, valves, and gauges	50	10 ,,	5
Belts	32	10 ,,	3
	£1,092		£84
Power, 63,500 KW.-H. at 0·6d. per unit	..	..	158
Lubrication and maintenance	..	..	20
Repairs	..	..	8
Part salary of engineer	..	..	48
Cooling water	..	..	4
	..	..	£322

The cost of compression is thus £322 for 8·974 million c.ft. or 8·5d. per 1,000 c.ft., this being the figure taken in the previous calculation. It is a maximum figure since a plant reserve of 100% is not always necessary.

The distributing station will also have to bear the cost of a stock of circulating cylinders. Though a load consists of 45 cylinders, in practice 50 are required to take care of repairs to valves, &c. With an amortization period of 20 years, the cost per 1,000 c.ft. of gas will be 0·3d.

The costs of an inspector for the consumers' installations will be 1·2d. per 1,000 c.ft. The inspector would travel on the lorry, his expenses being covered by a sum of £2 per month.

The total cost of distribution of compressed gas will thus be as follows per 1,000 c.ft.:

	s.	d.
Transport	1	6
Compression	0	8·5
Amortization of stock of cylinders	0	0·3
Inspection	0	1·2
	2	4

This represents the cost which must be added to the normal price of gas.

Canvassing costs are preferably included with installation costs and not as a part of distribution costs. They may be covered by a fixed annual payment of £50 to a canvasser travelling on a bicycle, motor cycle, or small car, depending on the distance, together with allowances of 10d. per day for travelling expenses and a commission of 1s. 8d. for every order secured for an installation of two cylinders.

In a later paper in the issue for Aug. 5, of the same journal (pp. 390-394), the author refers to the fact that domestic compressed gas installations require a two-stage reducing valve so that the high pressure of the gas may safely and smoothly be cut down to the low pressure at which household appliances work. The characteristics of a number of suitable valves are described and particulars of their performance are given.

Some Works Methods Adopted at Ballymena

By C. W. Surman (Ballymena)

[Paper presented at the Annual Meeting of the Irish Association of Gas Managers, Belfast, Aug. 14.]

In presenting this paper to you, I would like to state at the outset that no claim is made of having accomplished anything out of the ordinary. It is, I think, however, generally known in Ireland that the Ballymena works a few years ago was in low water and needed considerable overhauling if its working efficiencies were to be improved. During the last few years many alterations have been carried out, the following being a list of the more important ones:

Installation of a new station governor.
Installation of exhausting machinery.
Installation of boosting machinery (now dismantled).
Installation of new two-lift spiral-guided gasholder in steel tank (150,000 c.ft. capacity).
Alterations to coal stores and the reroofing of the principal buildings with corrugated asbestos sheets.
Rearrangement of a block of buildings and carrying out the necessary alterations, thereby making them suitable for a distribution stores, meter stores, and fitters' workshop.
The dismantling of the old bench of horizontal retorts and carrying out the necessary alterations to the building, thereby making it suitable for a boiler house.
The installation of a second Cornish boiler and the putting down by direct labour of its seatings.
The pulling down of an old sulphate of ammonia plant and its buildings, thereby making room for the erection of a tar-loading ground, recessed from the main roadway through the works.
The dismantling of buildings at the entrance to the works, thereby enlarging the main entrance, and the putting down of a complete new roadway through the works.
The dismantling of a portion of the Manager's house, carrying out the necessary structural alterations, thereby converting the whole building into showrooms and offices.
The laying down of 4 miles of new gas mains ranging in size from 12 in. to 4 in.

The above are tabulated as a matter of interest and it is gratifying to be able to record that the policy of the gas committee of adopting go-ahead methods has been amply justified, as not only has the appearance of the works considerably improved but the efficiencies have increased, and this, combined with good service and selling methods, has resulted in the sales of gas increasing from 37,454,834 c.ft. in 1926, when the price of gas was 7s. 6d. and 6s. 9d. per 1,000 c.ft., to 59,140,000 c.ft. in 1933 with a price of gas ranging from 2s. (industrial) to 3s. to 4s. 6d. (domestic). In addition, an optional tariff scheme was adopted by the Council a few weeks ago.

Below I give a few details of some of the plant and also some of our methods of working, &c., in the hope that they will prove interesting.

Carbonizing Plant.

The carbonizing plant consists of two settings of four vertical retorts each heated in units of twos. Before alterations were carried out, each one of the two producers supplied the producer gas to heat four retorts. As soon as it was necessary, therefore, to put the second bed under fire, the two producers were in operation. The daily rated capacity of the installation is 2¼ tons, giving about 320,000 c.ft. of 450 B.Th.U. gas. The calorific value supplied by us is 420 B.Th.U. and we find that this value gives very satisfactory results in the district apparatus, provided the quality and station governor pressures are kept constant.

After much experimenting, we have found the best method of working our retorts in order to keep a constant quality and make per hour is to keep three factors constant—viz., steam admitted to the base of the retort, heats, and pull of the exhauster. In our case we work at a steam pressure of 22 lbs. per sq. in., which is automatically controlled through a reducing valve; the West-Taylor valves are set at 9 notches; the combustion chamber temperatures are kept constant all the way up at about 1,250° C., with the exception of the two tops which act as circulating chambers; the pull at the inlet of the exhausters is 2½ in. W.G., and this is reduced to 1½ tenths at the inlet of the retort house governor, which gives level gauge at the tops of the retorts. With these three conditions constant we control the quality entirely by means of extractor speeds, and we have found this method to be best suited to our purpose and yielding constant and efficient results.

When I took charge in 1927, the coal used was a first-rate Yorkshire, the efficient carbonization of which necessitated high heats. With a low calorific value we found it was difficult to break down the gas quality although heavy steaming was practised. The throughputs had to be slow and, consequently, the hourly makes were poor, and we were of opinion that a cheaper gaseous therm would be produced by using a coal which would travel quicker through the retorts and so speed up the daily production per retort. It was decided, therefore, to experiment with double-screened Scotch coal, and the results obtained have justified our expectations. During the winter time we were able to work with approximately 10% less carbonizing plant, and the advantage of this was particularly felt during the change of seasons, when it can readily be understood that we were able to dispense with the services of the second bed for longer periods on account of the bigger makes per retort from the remaining bed, with consequent saving in fuel consumptions, &c. We estimate that the cost of production by adopting this course was reduced by 4d. per 1,000 c.ft. of gas made, equal to 1·190d. per therm, this figure including the reduced price at which the Scotch coals were able to be purchased.

After this we decided to carry our experiments a stage further and mix a cheaper variety of Scotch nuts with the coal, and we then found that we were able further to increase the throughputs by approximately 8% without resulting in decreased makes per ton or higher calorific values. The mixture adopted was 50% coal and 50% nuts, and we estimate that the cost of production was reduced by a further 0·3d. per 1,000 c.ft. of gas made.

Coal Blending.

I should like to mention here that there is far more in this question of coal blending than we on the smaller works are able to fathom, owing to the lack of chemical analysis facilities, &c. It is our practice, however, and one we find pays for the trouble entailed, to be very careful with the mixtures. Two loads of equal weight, one coal and one nuts, are laid at the breaker, and the "elevator man" stands in the centre and throws alternate shovelfuls into the pit, so that the fuel in the bunkers does not lie sandwich fashion and enter the retorts accordingly, but is, so to speak, a thorough blend.

Before leaving the carbonizing plant I would like to mention one or two other points. At one time we were greatly troubled with large pitchy accumulations forming in the collecting mains, foul main, and seal pot, necessitating having to shut down periodically on a Sunday to clear out the deposits. The trouble was overcome, first, by improving the conditions of the pull (which now has no variation) and, secondly, by pumping through the mains a continuous stream of thin crude tar.

Another trouble we had was that a very heavy fuel consumption was in evidence, occasioned by several causes, one of which was the question of slow throughputs already dealt with. There was, however, another serious cause—namely, the necessity at the change of seasons to work the fifth retort at intermittent periods—and this necessitated having two producers at work, one of which was employed solely to heat one retort, with consequent heavy fuel consumption during the periods. Our producers were of ample area, and we asked West's Gas Improvement Company, Ltd., whether it would be possible to bring the setting into line with later models by putting in a flue common to both producers, thereby making it possible to work extra retorts from one producer. The Company submitted a scheme showing that this could be done; the work was put in hand, and we are now able to work satisfactorily six retorts from one producer. Not only has this proved a great convenience by giving more flexibility but it has also enabled us to increase our "coke made for sale" by 0·3 cwt. per ton of coal carbonized.

Maintenance of Carbonizing Plant.

Probably no portion of time and money spent on maintaining plant in a state of efficiency is so remunerative as that spent on the maintenance of carbonizing plant. We

have found that it is well worth while to exercise the closest control over every detail and carry out a systematic maintenance programme. Under this heading falls scurfing, the method of which is, of course, well known. In our case we scurf at regular three-monthly intervals and no opportunity is then lost of inspecting the retorts whenever they are open for that purpose. We test for leakages, and any so found are patched with a silicious cement; we also coat the tops after every scurfing period with a well-known fire cement, and we find that this gives a protection to the brickwork at the point where it is likely to get the greatest abuse owing to rodding operations. In addition to the usual day-to-day routine, we make a practice every year of crawling, pointing, and washing the bench of retorts off work during the summer season, examining all valves, extractor and other machine parts and making any adjustments or renewals necessary, as well as carrying out any repairs to the brickwork of producers or settings, &c. We have found that by this systematic maintenance the plant is always kept up to concert pitch and can be relied upon to give the desired results at all times without risks of breakdown occurring at most inconvenient times.

Closely allied to carbonization, especially with vertical retorts, is the question of storage accommodation, for the best consistent results cannot be obtained unless it is possible to be able to work fairly constantly without having either to slow down production by reducing throughputs or putting off retorts. Six years ago, Ballymena was handicapped in this respect; there were two holders, the total capacity of each being 60,000 c.ft., while the heavier No. 1 holder threw 5½ in. W.G. cupped and 3 in. W.G. uncupped, and No. 2 holder 5 in. W.G. cupped and 3 in. W.G. uncupped. At that time the heaviest outputs of gas occurred from 4 p.m. to 10 p.m. during the winter period. The pressure supplied at the outlet of the station governors is 45 tenths.

It will be seen that the useful working capacity of the holders was only 60,000 c.ft., and after that uncupping occurred, with disastrous results to the district supply. In order to save this uncupping as much as possible, during the winter of 1927 it was necessary to have each holder full to blowing point at 4 p.m. each day, speed up the throughputs during the period and put an extra retort in make. We anticipated that when a quantity of new trunk feeder mains were put down during the spring of 1928 the outputs in the winter of that year would be still higher, which they were by an average of 30% during the 4 p.m. to 10 p.m. period. We had, however, taken the precaution of putting down a Keith-Blackman booster during the summer period, and this saved the situation in the winter, and, in the year 1929, it was decided to face the expenditure of extra storage accommodation. A new two-lift spiral-guided holder in steel tank was erected, with a capacity of 150,000 c.ft. Additional land adjacent to the works had to be purchased; the ground was heavily inclined, and it was necessary to remove about 2,500 tons of earth in order to bring the new site to yard level and commence the foundations. This being done, the foundations were put in, and the erection work commenced six weeks after the concreting work was finished. The holder was put to work in October, 1929.

It may be interesting to mention that the holder was constructed to throw 6 in. W.G. pressure when uncupped, when fully inflated the total pressure thrown being 9 in. W.G. It can be seen, therefore, that this holder can be used effectively right down to the last sheet without any adverse effect on the district pressures. The connections were also so arranged that gas can be fed from it to either of the other two holders and that any of these three holders can work independently on the supply to the town. By the installation of the new holder the unaccounted-for gas figure was reduced by about 3%, due to no blowing being in evidence, which often occurred previously about 3.30 p.m. during the winter period, and, also, the make per ton during the winter season increased by approximately 1,000 c.ft. We estimate that these two items amounted to an annual saving of about £220, which is approximately half the total annual interest charges payable on the loan.

Exhausters.

I have mentioned previously what is, in my opinion, a most essential characteristic in obtaining efficient results with carbonizing plant—namely, a constant level gauge at the gas offtakes—and this cannot be obtained unless the exhausting machinery is suitable and in first-class condition. Before the Ballymena undertaking installed verticals, the equipment consisted of an old vertical pattern exhauster and a small 10,000 c.ft. per hour four-blade, steam driven machine. The control governor in operation was a butterfly valve working in a 3-in. auxiliary by-pass and operated by means of a bell governor, quadrant, and chain. The vertical exhauster proved very inefficient for vertical retort work, and the small four-blade machine, which was in a bad state of repair, was replaced by a new 30,000 c.ft. per hour four-blade machine. The small machine was subsequently sent to the makers for complete overhaul, and the old vertical machine pulled out and scrapped and the reconditioned machine installed in its place. The plant, therefore, now consists of two machines, one 10,000 c.ft. per hour and one 30,000 c.ft. per hour, both being controlled by the usual steam throttle valves operated by means of control governors.

At first we found that we were unable to maintain an accurate and constant vacuum, which we attributed to the butterfly by-pass control working out of synchronization with the steam throttle controls. We therefore scrapped the by-pass control governor and its butterfly valve and inserted a 3-in. ordinary rack and pinion valve in the auxiliary by-pass, which is partially opened by hand, if and when necessity arises. Since this has been done we are able to work with a variation of not more than one-tenth in. W.G.

Our method of working is as follows: The control governors are set to maintain a vacuum of 2½ in. W.G. at the inlet of the exhausters. In the case of the small machine, its speed is maintained at not less than 70 r.p.m., and in the case of the larger machine the speed is maintained at not less than 40 r.p.m., since when the speeds fall below these figures we find that larger variations of vacuum are in evidence. The machine having been set, and subsequently, owing to the make of gas being less, due to putting off a retort, and the exhauster, in consequence, not travelling so quickly, the machine is re-timed and brought up to the proper speed by partially opening the auxiliary by-pass and passing a requisite quantity of gas back from outlet to inlet. Each machine has a run of approximately six months, the small one during the summer and the larger one during the winter. When either machine comes to its "off" period, its steam engine is completely overhauled, the end cover of the exhauster is removed and the inside of the machine inspected, cleaned out, and any defective springs renewed.

Once every day the exhauster is turned by hand and periodically it is run on "air" for a few hours to keep everything free. Enough attention is not always paid to exhausting machinery and its functioning, especially on some of the smaller works, it being looked upon as always safe and taken too much for granted, although it is the "heart of the works." We have found that the trouble and money spent on its efficient maintenance is amply repaid by the more regular and efficient results obtained from the retort house.

Disposal of Crude Tar.

In the smaller works it is not always a financial proposition to install tar dehydration plant. In our own case we have gone into the question and have found that the installation of such plant would not be advantageous or profitable to the Undertaking, and, no doubt, similar conclusions have been formed by some of the other similar undertakings. The usual method, therefore, is for the crude tar to be sold to distillers, they sending supplies of empty barrels and collecting full ones. In very many instances these barrels are filled by means of an ordinary hand operated pump fixed directly over the well, and the surplus barrels are stored at odd places in the vicinity of the wells, taking up valuable space and detracting from the neat appearance of the works.

Such a practice was in vogue at Ballymena until we erected what we call a "tar loading ground," a sketch of which is given in fig. 1. This consists of a piece of ground 3 ft. 6 in. above the yard level and measuring approximately 42 ft. by 27 ft. The ground is levelled off, the floor paved, and a front retaining wall built. Erected in one corner of the loading ground is a circular tank 4 ft. above floor level. Tar from the vertical retort house runs into No. 1 well, which has a capacity of 12,000 gallons, and from there it is pumped into No. 2 well, which has a capacity of 2,000 gallons. Here it is allowed to settle for several days. From No. 2 well the tar is pumped into the receiving tank on the loading ground, which is fitted with a 3-in. cast-iron overflow pipe running back into No. 1 well. The height of the floor of the loading ground from yard level corresponds with the height of the average lorry and cart bottom, the empty barrels being simply rolled off the lorry on to the loading ground and, afterwards, any full ones awaiting collection rolled direct on to the lorry. Empties are easily rolled under the 2-in. loading tap fitted at the base of the receiving tank and the tar flows into them through a large funnel inserted in the barrel bung hole. A 2-in. connection is taken from the pump delivery adjacent to the receiving tank, whereby tank lorries can be filled direct from the pump when desired. Since we erected this arrangement one man fills as much tar in six hours as

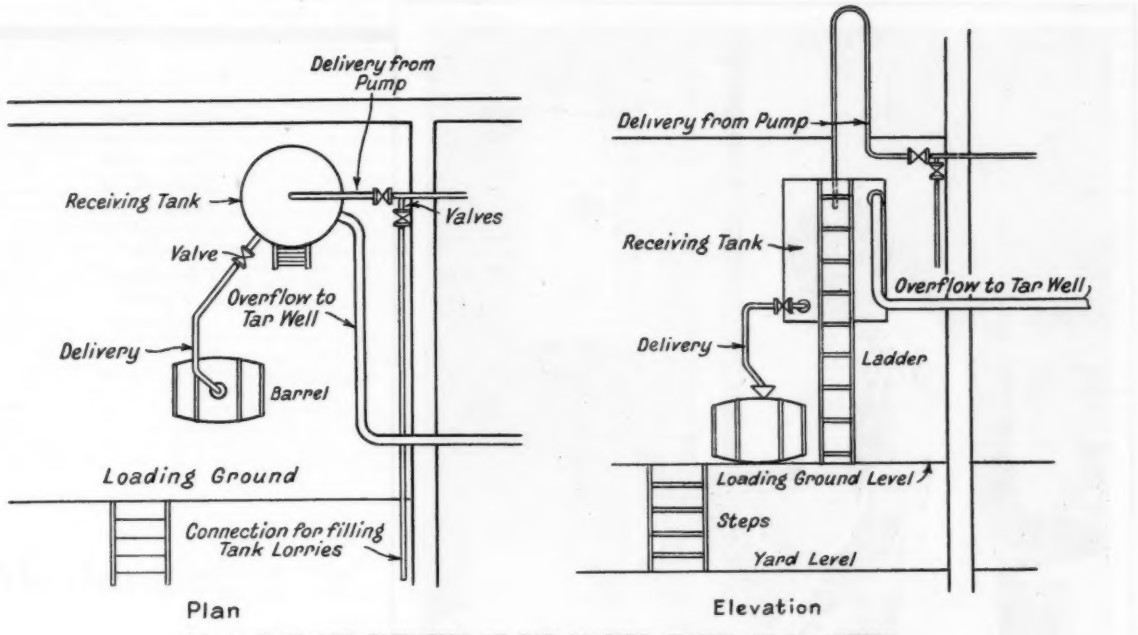


FIG. 1.—PLAN AND ELEVATION OF TAR LOADING GROUND AT BALLYMENA.

it took two men 1¼ days to do previously. I do not claim that there is anything wonderful or that there is a great saving in such an arrangement. But it is extraordinarily simple and has proved a great convenience to us and has made tar handling and disposal what may be termed a "self-contained department," quick and efficient, and a point, to my mind, of great importance, it has certainly enabled us to keep our works very much cleaner, tidier, and free from the stray barrel nuisance.

Chemical Facilities.

I think it will generally be agreed that small works, through lack of chemical facilities, are unable to know as much about the composition of their products and the effect of any new experiments they may be trying as are the larger works, who have a well-equipped laboratory and a trained chemist. The small works, of course, cannot hope to employ a trained chemist and run its plant under strict chemical control. I am one of those, however, who hold the opinion that the small undertaking can do much more in this respect than many of them are doing. It takes comparatively little money to purchase the chemical apparatus for the carrying out of the ordinary works tests and very little time for the manager to train an intelligent member of his staff in the use of the apparatus. We at Ballymena at present have no laboratory facilities, but it is our intention in the near future to convert a spare room into a small laboratory, in which will be housed the usual calorimeter apparatus, simple gas analysis, other apparatus for making elementary tests to give us a guide as to the quality of our product, and the raw materials, &c., and I see no reason why some member of the staff cannot be trained to use the apparatus. I am convinced that this will enable us to save money and to have more confidence in the quality of the product we are selling by enabling us more readily to detect any irregularities in our workings.

We hear in these days of intensive electrical competition many papers and discussions on sales methods, all of them having for their object the popularization of gas in the eyes of the public. It is, of course, very necessary to have up-to-date methods on the district and a keen sales department in order to sell that which has been well and truly made. I am one of those, however, who hold the view that, in addition to the proper constitution of the manufactured article and the sales methods employed, the "standing" of the source of supply also has a far-reaching psychological effect upon the public mind. The electricians boast of their up-to-date, well-laid-out, and cleanly power stations, and even the man in the street, at the mention of the words power station, immediately pictures a well-run and well-groomed department. How often can this be said of gas-works, especially the smaller ones?

Untidy gas-works may be efficient and well run, but, to the uninitiated, they present a picture of inefficiency and a necessary evil. It is not possible for all gas undertakings to be blessed with surplus moneys which can be spent on luxurious layouts. It is possible, however, for all gas concerns to make the best of what is at their disposal by having their works clean, tidy, and with that well-groomed look about them, and so convey to the public mind and to the staff the idea of efficiency, prosperity, and progression. I am convinced that this, in turn, will have its effect upon the standing of gas generally by giving the product a good name at the very commencement of its journey to the consumer, and this will help materially in the pushing of its sale against its younger and popular rival.

Discussion.

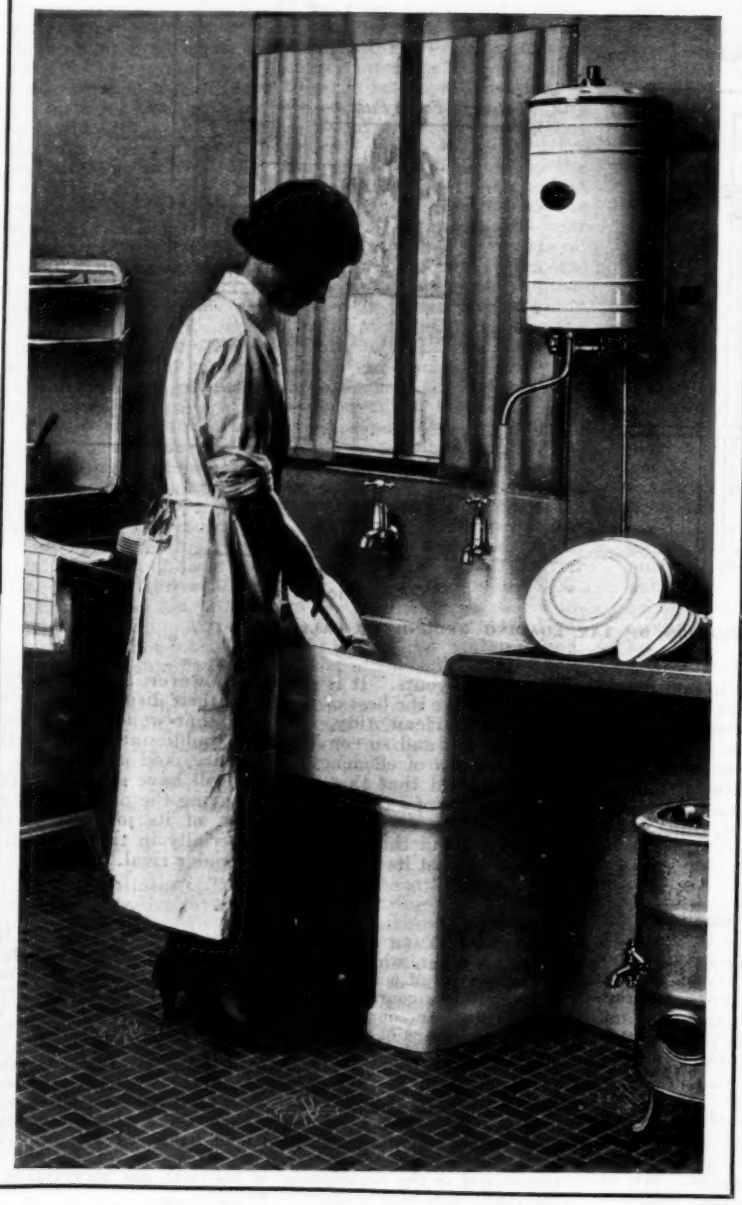
Col. W. M. CARR said he had been greatly impressed by Mr. Surman's paper, which emphasized the great value of courage in the control of a small gas-works. The paper afforded proof of the author's courage in the development of his undertaking. He had had the courage to seize the opportunity to reduce his price, as a means of obtaining the load, and then, when he had obtained the load, he was able to spend money and improve his service to the consumers. The paper illustrated the desirability in all cases of having the courage to look ahead. If they were to secure business, it could be done only by first of all fixing a price which they could afford to charge, not with the existing output, but when the increased load had been obtained. He congratulated Mr. Surman upon the excellent work he had accomplished in the development of his small gas undertaking as the result of a very progressive policy.

Mr. J. M'NICHOLL (Cork) pointed out that two years ago Mr. Surman gave a paper before the Association on "Some Sales Methods Adopted at Ballymena," and in that paper he showed them how he went about obtaining the load in order to justify the extensions which he had outlined that morning. The papers were complementary. In approaching a paper of this kind they had to consider, not the amount of gas made, but the fact that the sales of gas had increased from 37½ million c.ft. in 1926 to more than 59 millions in 1933. Such an increase in the short space of seven years was quite a big achievement for a works of that character. He noticed a statement in the paper which read as though from 2¼ tons of coal the author made 320,000 c.ft. of gas. There was evidently some mistake here.

Mr. SURMAN: That is the total production per day for eight retorts. It is 18 tons of coal carbonized per day.

Feather-Weight Inner Lifts.

Mr. M'NICHOLL (continuing) referred to what the author had to say on the selection of coals. Many engineers imagined that they were able to use nothing but the best coals, but the author had proved that this policy was not always the best one. It would be interesting to know what effect the change of coal had on the quality of the coke and on the yield. The author had stated that by the new firing arrangements they had been enabled to increase the "coke made for sale" by 0·3 cwt. per ton of coal carbonized. He felt he must congratulate the author on his foresight in providing a heavy inner lift for his gasholder. In his (the speaker's) opinion boosters were only a makeshift at best, and he hoped they had heard the last of these feather-weights for inner lifts of holders. The holder was not a very large one, and he would be interested to know what was the maximum daily consumption. He had nothing but praise for



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the paper; the progress shown was plain enough for anyone to see. The author had increased his output of gas 50% in seven years, and at the same time he had reduced the price by 50%. It was an achievement which ought to impress any Board of Directors or Gas Committee, and he hoped Mr. Surman's Committee were duly impressed.

Mr. A. S. BROOK (Lisburn) said he remembered going to the Ballymena works a good many years ago, and at that time they were certainly not very well arranged. It had been a splendid opportunity there for a young man, and Mr. Surman had availed himself of it. What was the tariff scheme that the author mentioned as having recently adopted? With regard to the thermal value of gas in Ulster, he would like to point out that they were making various qualities. If they had a uniform quality the comparisons which were so frequently made could be placed upon a proper basis. He did not agree with the author as to dehydration. It was his opinion that if Mr. Surman put down a plant and did not even operate it, he might for certain reasons be able to make it pay.

The PRESIDENT said he would like to congratulate Mr. Surman upon the way in which he had put his whole energy into the job. He deserved the very greatest credit for the reconstruction work he had carried out at Ballymena.

Mr. SURMAN said the reference to the production of the retorts might have been not very plainly put in the paper, but what it was meant to convey was that the total daily production of the retorts was 320,000 c.ft., and the throughput per retort was about 2¼ tons. By the change from Yorkshire to Scotch coal the quality of the coke to some extent suffered. It was smaller and rather more ashy. But they found out the type of coke that suited the principal consumers, and were very careful not to go outside this. The total production left over for sale was 5 cwt. per ton. It was not a big figure, but there was great difficulty in a small undertaking, with the change of seasons. When one used fewer retorts, the same fuel consumption was required. In connection with some of the later plants (their own was of the 1921 Model) he thought this matter had been looked into, and the fuel figure had been improved considerably. The maximum daily output was 288,000 c.ft., and the storage capacity, at 270,000 c.ft., covered practically 24 hours. Now the output was much more evenly spread over the 24 hours than was formerly the case, and the present storage they hoped would remain ample for a few years to come.

As to the tariff scheme about which Mr. Brook asked for information, he might say they had now four rates—for lighting, for heating, for industrial use, and the tariff. In certain instances it did not pay people to go on the tariff rate, but in lots of cases it did pay them to do so, rather than to take supplies at different rates for lighting and heating. The charge for lighting was 4s. 6d. per 1,000 c.ft., for heating 3s., and for industrial uses 2s. The tariff rate was principally 2s. 6d. per principal room per quarter, and gas at 2s. per 1,000 c.ft., or 5·8d. per therm. The desirability of a tar dehydration plant depended mainly on the price received for one's crude tar.

Modernizing a Street Lighting Installation

By T. Tallentire (Lurgan)

[Paper presented at the Annual Meeting of the Irish Association of Gas Managers, Belfast, Aug. 14.]

The street lighting installation which forms the subject of this paper, and which is maintained by our Department, consisted of, prior to modernization, some 230 lamps, all of which were 14 in. square heads, mounted 11 ft. from the kerb to the light source. The source consisted of a swan-neck burner fitted with a universal size mantle, with the exception of 34 lamps, which were fitted with a cluster burner of three No. 1 mantles. All the lamps were automatically controlled with wave pressure controllers. In addition to these gas lamps there were 30 electric lamps which were not maintained by our Department.

Owing to the ever-increasing fast motor traffic through the town, and the rapid building up of the outskirts, it became imperative that a much higher standard of street lighting should be maintained in the interests of public safety, so it was suggested by the local authority to install a further number of electric lamps in place of a number of existing gas lamps.

Experimental High-Power Gas Lamps.

About this time our Department erected a few modern high-power, low-pressure lamps on two of the main thoroughfares of the town. The lamps used were nine-light Rochester suspension type, and they were suspended from brackets erected on the existing columns. In order to raise the light source 15 ft. from the kerb, a cast-iron extension piece was fitted between the top of the column and the base of the bracket.

This demonstration proved so successful that the local authority decided immediately to have these two thoroughfares lighted with this type of lamp.

These streets averaged 40 ft. wide between the kerbs, and the new lamps were erected 50 yards apart on alternate sides of the street. They were suspended from wrought-iron brackets mounted on fluted steel columns, at a height of 15 ft. from the light source to the kerb. Each lamp was fitted with a multi-face wing type stainless steel reflector, a deep wing being fitted to the house side of the lamp, and a shallow wing to the road side, the depth of the wing on the road side being determined by curtailing its depth so that the shadow it formed commenced at a point on the opposite side of the street where the footpath meets the side wall of the houses.

The wave pressure controllers by which these lamps were controlled were housed in a box situated between the top of the column and the bottom of the bracket, the by-pass tube being fitted internally to the bracket. This arrangement, however, was not found successful owing to condensate forming in the by-pass tube and running back into the by-pass regulating screw and sealing it, so extinguishing the pilot light. However, this was overcome by changing the controllers to the suspension type which were fitted between the lamp and the top of the bracket. While these overcame the condensate trouble, they were not found to be entirely satisfactory, as, owing to the swaying of the lamps in the wind, the mercury sealing the bell of the controllers was frequently spilled, thus putting the controller out of commision by allowing gas to escape.

Increasing the Illumination in All Thoroughfares.

That this section of modern gas lighting was a success was evidenced by the fact that, shortly after completion our Department was instructed to prepare a scheme to bring all the streets in the district up to the standard now set by this experimental section, including the portion of the town which was lighted by electricity.

The scheme that was prepared and approved was as follows:

(1) To increase the number of square head lamps by 30 and, by so doing, bring the spacing of these to a standard which was set at 40 yards apart on alternate sides of the street. (2) Each lantern to be fitted with a cluster burner of three No. 1 mantles. (3) All lamps situated on a second-class street to be fitted with a multi-ray reflector. (4) To erect 11 six-light high-power lamps on the one remaining first-class street. (5) To fit high-power lamps to all the standards carrying electric lamps and replace the electric flood lights by gas.

The first portion of the scheme to be started was the erection of the six-light "Rochester" lamps, which were erected on similar steel columns to those used for the nine-light lamps, but the spacing was made 40 yards apart on alternate sides of the street, owing to the lamps being smaller. This, together with the fact that the street was 10 ft. narrower, brought the lighting within the same class. The mounting height was also slightly less than in the nine-light installation—that is to say, 13 ft. 6 in. instead of 15 ft. All the lamps were fitted with multiple-face wing type reflectors, and were controlled with suspension type wave pressure controllers. The only difference to the nine-light arrangement was the fact that they were all fitted with constant pressure governors.

The re-spacing of, and addition to, the small lamps was then commenced on the second-class streets.

The new lighting units fitted consisted of a cluster burner of three No. 1 mantles. The burner injector was non-adjustable, and was drilled to pass the required quantity of gas at 30-tenths pressure, the pressure being kept constant by a governor on each lamp.

The existing clay by-pass tips were replaced by the all-metal "Equinox" type, which eliminated the use of an adjusting screw and reduced the gas consumption by 50%. The wave pressure controllers which had been in use for some years were utilized, and each lamp was fitted with a multi-ray reflector. In any case where the existing porcelain top reflector was stained or damaged it was replaced by a new one of the stainless steel type. All other small lamps situated in back streets, courts, &c., were overhauled and fitted with a new burner equipment only,

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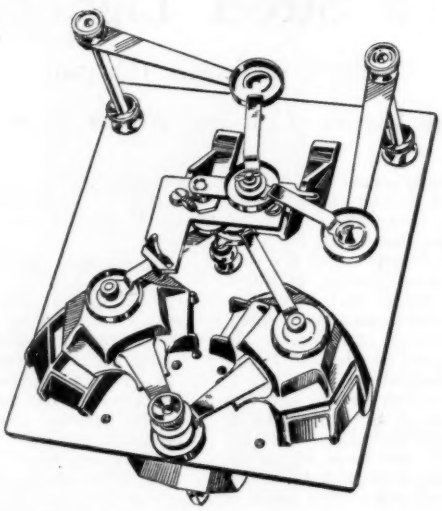

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that is with the fixed injector and new by-pass but without directional reflector.

Conversion of Electric Lamps.

The final part of the scheme was next commenced, that was the conversion of the electric lamps to gas, and that presented many difficulties. In the first place, the spacing of these was very irregular, as also was the mounting height, and owing to the fact that they had only been erected three years and were all set in concrete foundations, it was not desirable to alter their positions. The power of the lamps varied from 100 watts to 500 watts, and the type of unit from the well-known Holophane to the more modern multiple face overhead reflector type.

To get over the difficulty of the irregular spacing and mounting height lamps of various sizes were used, varying from nine-light to fifteen-light. The type of lamp used was the same as used on other first-class streets—that is, the "Rochester" suspension type fitted with wing type reflectors on the lamps erected on the kerb, and multi-ray reflectors on the lamps erected in the centre of the carriage-way. There were two nine-light, three ten-light, 17 twelve-light, and eight fifteen-light lamps altogether, each fitted with a constant pressure governor, gas and air regulator.

For ease of maintenance use was made of the existing position at the base of the columns to house the controllers. To achieve this it was intended to use a wave pressure controller in conjunction with Sugg's distant control device, but it was found that the largest size wave pressure controller obtainable was too small for our purpose, so clock controllers were reverted to.

The type of controller used was the Horstmann solar compensating type. These controllers are constructed with an automatic advancing and retarding device, which is actuated by a cam, cut to suit the latitude of the geographical situation of the place wherein they are to be used. Each twenty-four hours' revolution, the tappets are automatically adjusted by a trip device to correspond with the alteration of the length of time between sunrise and sunset.

In practice all that is required is to set the clock to the correct time and keep it wound up, no manual adjusting to suit the varying lighting-up times being necessary.

The existing brackets on these columns were made from 1-in. wrought-iron tubing screwed into a cast-iron socket, which was held to the steel column by set screws. Unfortunately, these blocks were not tapped right through and, as the time was very short until the lighting season commenced, it was not possible to fit iron services, and it was decided to go against good practice and connect these lamps with composition pipe, threading it through the bracket and letting it hang by its own weight inside the column. A 1 in. by ½ in. male and female socket was screwed to the end of the bracket, and the inside of the ½-in. end was tapped to take ½-in. brass drop screw from the compo, this ensuring that the weight of the lamp when screwed to the ½-in. socket was taken by the bracket, and that no strain was put on the composition pipe. Instead of connecting the compo directly into the valve outlet at the controller it was terminated in a 12-in. syphon and sealed with water, thus overcoming the difficulty which would have been caused by the condensate running down the compo and sealing the by-pass in the clock valve. This syphon also acted as an automatic drain, eliminating the necessity of periodical draining as would have been the case if tail-pieces had been fitted.

While this acted very well, it could not drain that portion of the supply from the top of the lamp to the highest point of the bracket, with the result that, until we were able to replace the compo with iron pipe, the mantle breakages caused by the amount of condensate that collected during the day dropping into them was excessive.

While condensation is not so great with iron pipe as with composition pipe, the syphons were retained when the iron pipe was fitted, as very little water seals the distant control device by-pass in the clock valve, and it was found that the syphons completely eliminated all trouble from this source. These lamps, in common with all the other lamps, were fitted with constant pressure governors.

Floodlighting the War Memorial.

The existing floodlighting on the war memorial consisted of four units of 250 watts each, and were replaced by four of Sugg's seven-light flood lamps controlled by wave pressure controllers.

The memorial is circular in form, and the lamps are equally spaced around it, about 30 ft. from the centre. While the effect was very striking, owing to the fact that the memorial does not present any large area to the light source, much useful duty from the lamps is lost. Further, the memorial is higher than it is wide; consequently, in order to obtain a beam large enough in diameter to take in all the height, it proves much too large in relation to the width of the memorial.

The converting of the floodlighting to gas completed the scheme, and brought an installation of 230 square head lamps to a total installation of 304 lamps, made up of 230 square head lanterns, 70 high-power lamps, and four flood lamps, increasing the annual gas consumption from 2,500,000 c.ft. to 5,500,000 c.ft.

The lighting hours are half an hour after sunset to 11 p.m., with the exception of nine high power lamps which burn to half an hour before sunrise.

Maintenance.

The maintenance of the system is carried out by two attendants, who are required to clean each lamp at least once a week, effect all repairs (no skilled labour being used), wind the clock controllers and inspect each lamp three times daily—once after lighting, once after the half-time lamps are extinguished, and once after the full-time lamps are extinguished. It is found necessary to inspect every lamp at all these times, as with wave pressure controllers it is possible for any lamp to get out of cycle during any operation.

The attendants have also to watch all lamps during stormy weather. Before the introduction of governors this kept the men very busy, owing to the fact that the lamps fitted with wave pressure controllers had the tendency to go through the lighting operation during such periods, although, strange as it may seem, once lighted, the worst storm did not extinguish them. The only explanation of this seems to be that a strong gust of wind created a pressure inside the head of the lamp, and this was conveyed to the controller via the burner, which raises the bell, and thus completed the lighting operation. When the burner was lighted, however, any increased pressure in the lamp head could not find its way down the burner owing to the fact of the gas stream coming up, thus the storm had no effect during the time the lamp was burning. However, the introduction of governors set up enough resistance to any pressure created by wind to completely stop this tendency of the controllers to operate during non-burning hours.

While clock controllers combined with distant control devices are free from wind troubles, we find that they presented another form of difficulty with calls for very careful attention and setting.

The distant control device takes the form of a leather diaphragm from which is suspended a valve. When the full pressure of the gas is applied, the diaphragm lifts and so opens the valve, allowing gas to pass to the lamp. When the pressure at the inlet of the device is reduced, the diaphragm falls and shuts the valve, but allows the small amount of gas which by-passes the control valve to flow to the pilot light.

It was found that, if the by-pass control screw in the clock control valve was set to pass more gas than the pilot light on the lamp would consume, the main valve in the device became partly opened, but just enough to let the surplus gas away, with the result that the superheater of the lamp became filled with an explosive mixture, and when the full pressure was applied, instead of the lamp igniting quietly, there was a minor explosion, resulting in the loss of all the mantles.

Each time any lamp so fitted is cleaned, the setting of the device is checked. This is necessary owing to the fact that the by-passes "growing-up" would be by-passing slightly less gas, thus creating an increased pressure on the diaphragm of the device, with the foregoing results.

Effect of Concrete Streets.

During the "off" season it was the practice to take all lamps off their columns. This was necessary to avoid the damage done during the summer months from 'stone throwing, &c., and advantage was taken of this to repair any badly damaged lamp.

However, since the introduction of concrete streets, with the consequent lack of loose stones by which children are tempted, we can now leave most of the lamps in position all the year, thus saving much time and labour, and also a considerable amount on mantles. All the lamps which are not taken off are fitted with an asylum cock, so that they can be turned off without any fear of their being interfered with.

The mantle consumption in square head lanterns situated on non-concrete streets is 1·3 mantles per nozzle per season, compared with 0·6 mantle per nozzle per season in concrete streets. The high-power lamps which are all situated in concrete streets take 0·8 mantle. From these figures the beneficial results of concrete streets on mantle consumption alone are readily seen.

That well-maintained street lighting is an advantage to any gas department cannot be denied. While it is to be

admitted that it calls for increased responsibility and work, especially to the small works, it more than repays itself by raising the prestige of gas generally, which in these days of keen electrical competition and newspaper propaganda means much.

If all street gas lighting installations were modernized, while it would prove a great benefit to those using the streets and roads so lighted, the Gas Industry would benefit most and, therefore, should do all in its power to see that all street lighting is worthy of such an Industry, and I am convinced that any money spent on improving public lighting would prove a very good investment.

Discussion.

Col. W. M. CARR said this paper was to be welcomed, because it was delightful to see electricity turned out for gas in street lighting. Many of them were suffering in the opposite direction—and not always on merits. The paper showed clearly the advantage of proper maintenance and looking after the job; and he was certain that the results at Lurgan were brought about only by a progressive policy and by careful attention to the installation. At Stretford, where he controlled a local authority undertaking, he (Col. Carr) had the experience of not even being allowed to submit a price for street lighting, or to put up demonstration lamps, and this was a very difficult matter to contend with. He was very pleased to see that in Northern Ireland the local authorities were at least prepared to give a fair chance to gas, and to choose the best.

Mr. J. M'NICHOLL (Cork) said the author was to be commended for the vigorous policy he had adopted to keep up the end of gas in his district. He had shown great foresight in not waiting until he was asked to do something. This was the correct policy. It would be a good thing if some of the larger undertakings would follow this example. If they had adopted that policy in the past, he thought there would have been a different tale to tell to-day, though it did not follow that the same method would prove successful on every occasion. They did not all have the same fair-minded authorities to deal with, but given a fair field and no favour the inevitable result would be the same as at Lurgan.

Mr. A. S. BROOK (Lisburn) thought they were very fortunate in Lurgan in having a Council who were not afraid of spending money. He wished he could get his Council to do the same. He would be glad to have some information regarding costs, present and past.

The Lesson.

The PRESIDENT pointed out that the real lesson to be learned from Mr. Tallentire's paper was that if they wanted to retain their street lighting they could do it. In Belfast they had been able to retain more than 99% of the street lighting for gas, and most of it, they would agree, was pretty good. They must see that the lighting was really first-rate, if they wished to secure or to retain the business.

Mr. TALLENTIRE said the Lurgan Authority were no more fond of spending money than others, and he had had to keep this point in view. With the price of gas at 5s. per 1,000 c.ft. and of electricity at 4d. per unit the cost of the public lighting was £1,195 per annum. Now that the price of gas had been reduced to 3s. 6d., the cost of the new scheme, with its larger consumption, would be £1,204 a year—or an increase of only £9 for a very much improved lighting installation. The profit of the undertaking, after the reduction in price, was increased owing to the increased consumption.

Radiant Heat and Comfort

By Harold Hartley, D.Sc., Head of the Research Department, Radiation Limited.

[A paper before the Institute of Fuel, to which body we are indebted for the accompanying diagrams.]

(*Continued from p. 268 of the* "JOURNAL" *for August* 15.)

Variation of Endurable Time of Exposure with Intensity of Energy.

The intensities of the energy used in the tests just described were such as could be endured in some cases for periods up to 4 minutes, but the ability to withstand exposure varied appreciably with the subjects. It is of interest to know how the period of exposure which can be borne by a particular person varies with increase in the intensity of the energy from a particular source.

To test this point a series of experiments was performed in which an arm was exposed at different distances from the fire and the time recorded until the exposure produced the first sharp tingling sensation. This is a point which can be defined reasonably sharply after experience in this class of work. The individual whose arm was exposed to the fire merely reported his sensations, whilst another observer recorded the times with a stop-watch. In between each exposure approximately 15 minutes were allowed to elapse so as to ensure that all sensation of pain resulting from the previous exposure would be relieved. Throughout the series of tests, however, the exposed part of the arm was in a flushed state. On the following day the *rôles* of the two experimenters were reversed. The results attained are plotted in the curves of fig. 1. The left-hand curve relates to operator *A* and the other to operator *B*. It will be seen that each curve is regular, and we have the relation between intensity and time of exposure defined by an equation of the type

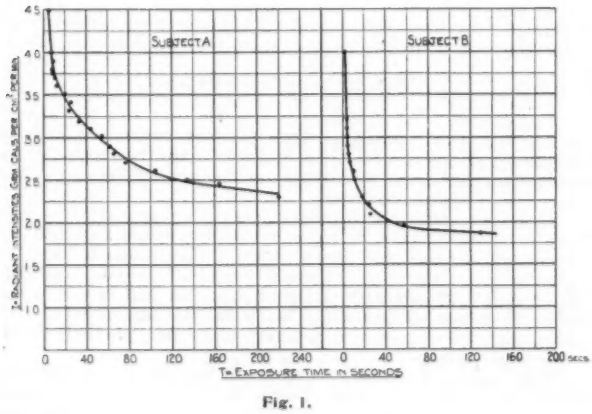

Fig. 1.

$$I\,T^{n} = \text{constant}$$

where I = intensity of the radiant energy falling on the arm, and

T = the time of exposure,

provided the intensity of the energy is adequate to produce the tingling sensation. It will be noted that the time of exposure required for *B* was less than that which *A* needed to produce the effect.

Threshold Intensity for Pain.

The experiments described in the previous section indicate clearly that when comparing the effects of radiant energy attained from different sources it is important to ensure, not only that comparative tests shall be made on the one person, but that care shall be taken to see that the intensity of the incident energy is accurately measured; a small variation in the intensity when this exceeds a critical value having a big effect on the period of exposure which can be endured.

Tests have been made with a number of different appliances to determine a heat intensity which we describe as the *threshold intensity for pain:* that is, the minimum intensity of energy which produces persisting pain. The heating appliance to be tested is fixed on a bench with the perforated screen and cradle in front of it. The naked arm of the operator is rested in the cradle, and a series of tests is made to find the minimum distance from the fire at which the arm can be supported so that no persistent sensation of pain is felt in less than 3 minutes. The minimum intensity at which such pain is produced we have termed the *threshold intensity for pain.* Mr. U. C. Evans, who has carried out all the "comfort" experiments for us, either on himself or on other members of our staff, finds he is able to repeat his results to approximately 0·1 cals./sq. cm./min. on a given day. The tests are carried

out with a flushed arm. Typical results are summarized in Table III.

TABLE III.

Source of Energy.	Threshold Intensity Cals./Sq. Cm./Min.		Penetrancy % (Brown Bakelite).
	Sub. A.	Sub. B.	
Dull electric radiator	2·6	..	4·1
Thermo beam gas fire at normal consumption	2·9	..	6·5
Cobble beam fire normal consumption	3·1	..	7·5
Clinical gas lamp, disc type—			
(*a*) Normal consumption . . .	3·2	2·03 2·08	11·8
(*b*) 100% pressure overload . .	3·4	2·30 2·30	14·1
Tungsten lamps in clear gas (no reflector)	3·7	..	31·3

We regard these results as of qualitative rather than of quantitative accuracy. The quantitative value of the intensity varies not only from individual to individual, but even with one person under different conditions.

The penetrancy figures in the third column refer to results attained with a screen of clarified brown Bakelite about ½ mm. thick. Further reference will be made to this matter later, but at the present stage attention is drawn to the fact that in general the source of energy giving the highest threshold intensity is also that which gives the highest penetrancy value, although an increase in penetrancy relative to the Bakelite does not produce a proportionate increase in the threshold intensity.

Infra-red Transmission Spectra for Skin.

Fresh human skin contains a considerable amount of water, removable on heating to 105° C. In addition, the

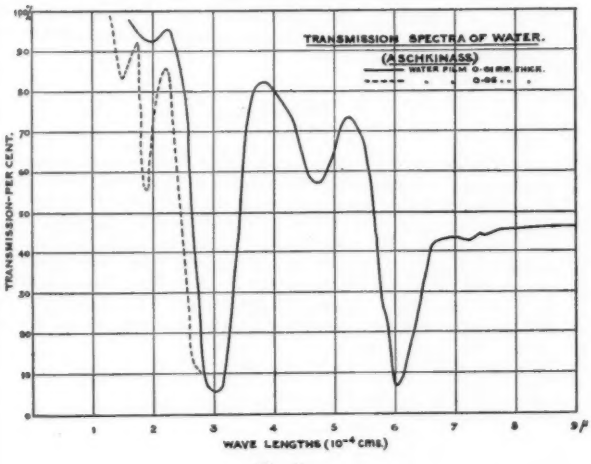

Fig. 2.

skin substance contains hydroxy radicles, so that the infra-red transmission spectra for the horny layer, the epidermis and the derma will reflect some of the characteristics of water layers. Julius, Paschen, Aschkinass, and others have studied the transmission of radiant energy through thin layers of water and have found it extremely opaque to infra-red rays. Fig. 2 shows two curves obtained by Aschkinass, the one relating to a water film 0·1 mm. thick and the smaller curve to a film 0·05 mm. thick. Absorption bands will be found at 1·5μ, 1·9μ, 3·0μ, 4·5μ, and 6μ.

We have measured transmission spectra for (*a*) moist rabbit bladder membrane, (*b*) clarified ox-horn, and (*c*) desquamated human skin. In order to avoid as far as possible error resulting from decrease of the water content of the bladder membrane during the experiment, the transmission determinations were made only at appreciable intervals. The results are plotted in fig. 3. The curve for desquamated human skin is known to be in error owing to scattering effects, which tend to lead to smaller penetrancy values with the shorter wave length. It will be noted that all three substances show heavy absorption in the region 3·0μ-3·5μ, the moist rabbit membrane showing, in addition, sharply defined water absorption bands at 1·5μ and 1·9μ. More recently H. J. Taylor has published in the Proceedings of the Royal Society* a transmission curve for desquamated skin attained under experimental conditions arranged to eliminate scattering effects. The curve is published in fig. 4. It will be noticed also that

* *Proc. Roy. Soc.*, A, Vol. 142, 1933.

Dr. Taylor records strong absorption at 3μ, and that in general he found the shorter infra-red energy not much more penetrative than the infra-red energy longer than 3μ with which he worked.

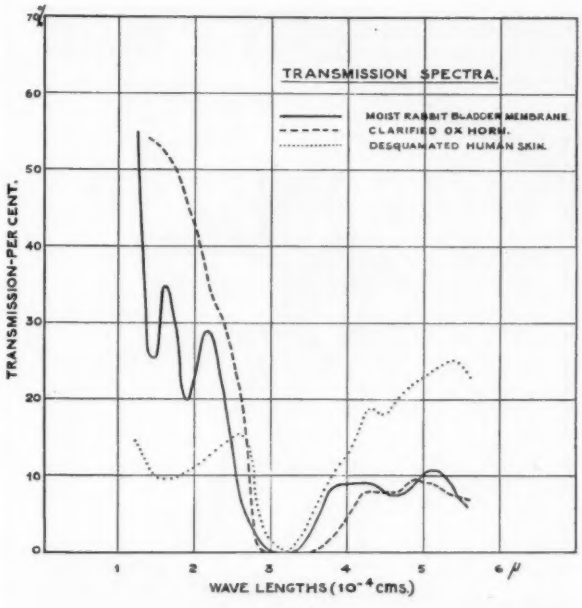

Fig. 3.

Transmission by Skin of Heat from a Gas Fire.

A consideration of the results represented by the transmission curves suggests that the longer infra-red rays may be very completely absorbed by moisture on the surface of the skin and in the upper living epidermal layers,

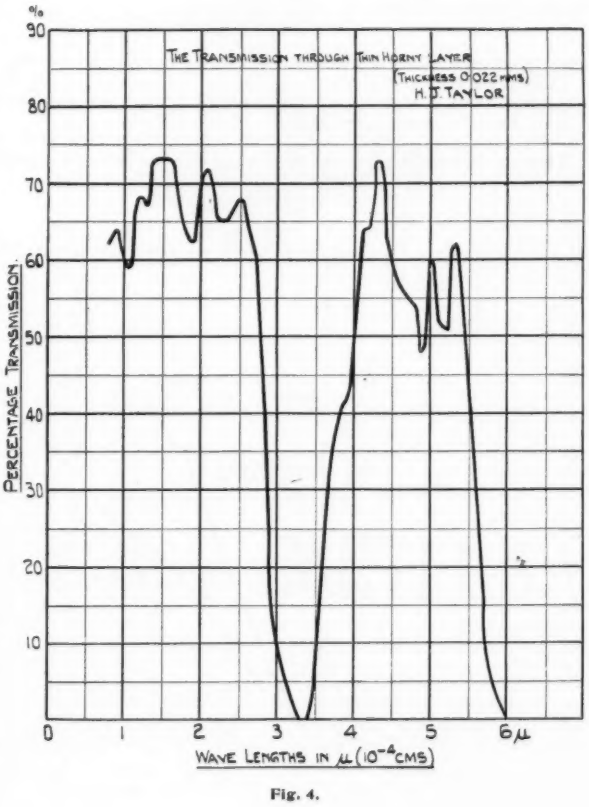
THE TRANSMISSION THROUGH THIN HORNY LAYER
(THICKNESS 0·022 MMS.)
H. J. TAYLOR
PERCENTAGE TRANSMISSION
WAVE LENGTHS IN μ (10⁻⁴ CMS.)

Fig. 4.

whence heat would be transmitted subsequently to underlying tissues by conduction. The visible and short infra-red rays, on the other hand, are more penetrative and may pass directly to the living cells of the skin, and possibly also to the blood circulating in the capillaries. The visible

red rays may, in fact, penetrate very deeply, not being wholly absorbed by the blood and tissues of the skin. For example, a glow-lamp held in the mouth in a dark

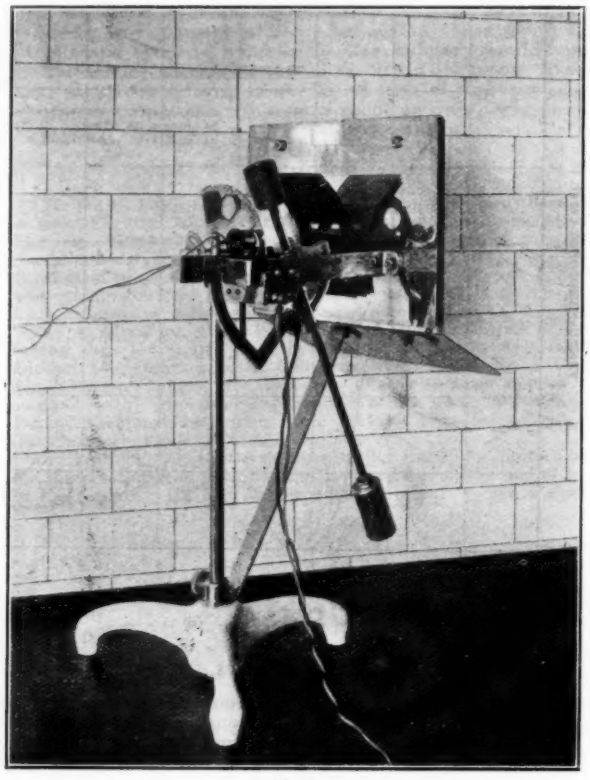

Fig. 5.

room causes a faint red shine in the cheek of a white man. This does not occur with a negro. The pigment in the epidermis of a negro absorbs the visible rays and protects the blood from overheating.

Experiments were carried out some years ago with a Thermo Beam gas fire to determine the amount of energy transmitted by different types of screen. Through the desquamated horny layer of human epidermis about 40% of the incident energy was transmitted, whilst through a piece of ox-horn about ¼ mm. thick the transmission was approximately 20% of the incident energy. Using the bladder membrane from a freshly killed rabbit, there was recorded transmission of some 14·6% of the energy at the moment of first exposure. Continued exposure of the membrane resulted in an increase in the amount of energy which was transmitted. Ultimately, after appreciable drying had taken place, the amount of transmission had increased to 45%. With a piece of shaven stomach skin (epidermis and derma) from a freshly killed rabbit, the initial transmission was 6%, whilst as the skin dried this increased to 20%.

Three pieces of human skin (epidermis and derma, (female breast), removed from an elderly patient during an operation, were examined and found to permit respectively of the transmission of 2%, 1½%, and 4½% of the incident energy from the same fire. These three specimens varied somewhat in thickness and possibly also in their water content. The whole of the under-fat had been removed from the skins, but the specimens were streaked with blood. Again, as drying took place there was a marked increase in the diathermancy of the samples. Our experiments have shown that the opacity of dead tissue to near infra-red and luminous energy at first decreases and then increases again with the passage of time.

Allowing for the thickness of the living human skin, it would appear that not only may a considerable proportion of the radiant energy from such a gas fire pass directly into the living cells of the epidermis, but some may also pass directly into the derma. The heating of the blood stream in the capillary vessels in and beneath the papillæ, resulting from the direct transmission of radiant energy, as distinct from that due to conducted heat, must, however, only be small for the more thickly covered parts of the body when the source of the energy is the particular fire under consideration. Where the skin is thin, as, for example, on the face, neck, and forearms, which are usually exposed to the fire, there is, as indicated previously, a direct transmission of radiant energy even into the tissue below the skin.

Penetrancy.

In Tables II. and III. penetrancy figures are quoted for the energy emitted by the sources under consideration. These refer to results attained with clarified ox-horn or bakelite screens. It seems not unlikely that variation in the sensations felt under the action of radiant heat may be connected with the power of penetrating the epidermis possessed by the radiant energy. It is desirable, therefore, to have available means of measuring the penetrancy of the radiant energy relative to the human skin. Unfortunately, samples of skin lose water and also age when they are kept in the ordinary atmosphere, so that other screens have to be used as standards. We employ clarified ox-horn (⅔ mm.) and clear (1·3 mm.) and brown (½ mm.)

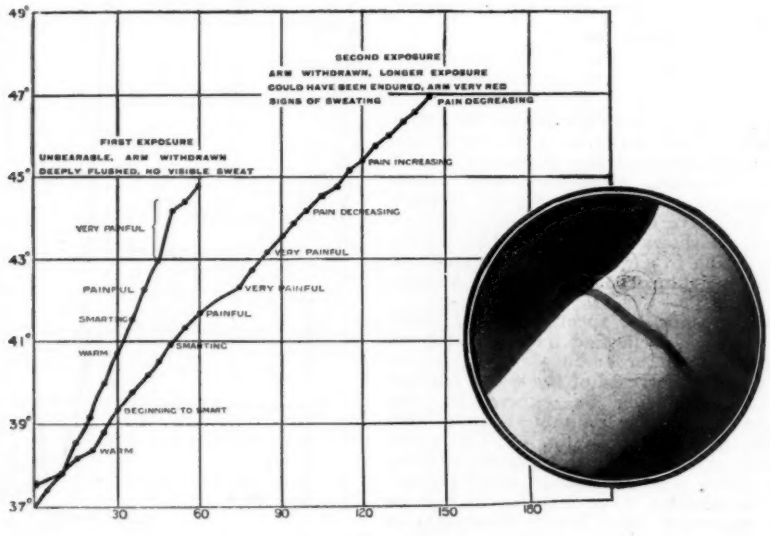

Fig. 6.

bakelite. The transmission curve for bakelite is very similar to that of skin in the short infra-red, but more opaque to energy of wave length greater than 3·5μ, whilst the clarified ox-horn transmission spectrum has been given already. In using screens of this kind it has to be remembered that there is appreciable absorption, so that when the screen is exposed to the source for any length of time it becomes heated, and thus an emitter of secondary radiation. The apparatus we use for measuring the penetrancy is shown in fig. 5. The screens to be used are fixed in the specimen holder, one of the openings being left uncovered. To measure the intensity of the incident and transmitted energy, a small Moll thermopile is employed, and this is clamped so that the hot junction face is just behind the specimen holder. The curved screen interposed between the thermopile and the fire is worked electromagnetically, and is held in the " off " position when the current is flowing. To make an observation the current through the electro-magnet is broken momentarily; the screen then moves from in front of the specimen holder under the action of gravity and swings back again. When the magnet piece of the screen comes into contact again with the electro-magnet it is held. In this way a controlled exposure of approximately $\frac{1}{2}$ second duration is attained and direct heating of the specimen is avoided. The deflection produced on the galvanometer by the Moll thermopile is measured with and without the screen in position. The figures given in Table IV. represent the percentages of energy from various sources which pass through the clarified ox-horn and bakelite screens.

TABLE IV.—*Percentage Penetrancy.*

Source.	Brown Bakelite. ($\frac{1}{4}$ Mm.)	Clear Bakelite. (1·3 Mm.)	Horn. ($\frac{1}{2}$ Mm.)
	%	%	%
Dull red electric radiator . . .	4·1	3·4	5·4
Coal fire.	5·9	5·5	8·1
Coke fire (bright)	6·8	6·9	9·8
Thermo beam gas fire at normal consumption.	6·5	6·6	9·4
High beam gas fire at normal consumption	6·9	7·2	10·1
Cobble beam gas fire at normal consumption.	7·5	8·4	11·5
Incandescent gas mantle . . .	8·3	11·9	14·4
Clinical gas lamp—			
(1) Normal consumption . . .	11·8	13·4	18·0
(2) 100% pressure overload . .	14·1	16·7	21·9
Tungsten (gas-filled) lamp—			
(1) White sprayed	29·8	50·7	58·3
(2) Pearl	30·8	56·0	62·5
(3) In clear glass	31·3	57·5	64·5

Subcutaneous Temperatures.

We have made a number of determinations of subcutaneous temperatures in the hope that the results would provide information as to the cause of the effects due to variation in the quality of the energy. Unfortunately, however, we were not able to standardize the conditions to our satisfaction. Using two sources, one of which had a higher comfort factor than the other, we attained a number of results, which seemed to show that the source with the higher comfort factor gave higher subcutaneous temperatures. On the other hand, we also attained a number of results which were directly contradictory. We found that the temperature which could be attained when continuing the exposure as long as was endurable was much influenced by the prior heating of the arm, whilst the pain due to the presence of the thermocouple (hypodermic needle) in the arm made it difficult to standardize the endurance limit. The curves in fig. 6 represent the results recorded in two successive tests by the one experimenter. The subcutaneous temperatures were measured at a depth of approximately 2 mm. Between the end of the first experiment and the second a period of 20 minutes elapsed, during which the arm was cooling down. In the first exposure the subcutaneous temperature rose very sharply, and the exposure had to be discontinued after 60 seconds, at the end of which time the temperature had reached approximately 45° C. In the second treatment, the temperature rose to 49° C. The exposure lasted for nearly 3 minutes, and could have been continued longer.

The inset in fig. 6 indicates the portion of the arm into which the needle was inserted, the area exposed to the heat being shown ringed. During the actual test the rubber band and wire connections were all shielded from the fire, only the area within the circle being exposed to the radiant energy.

(To be concluded.)

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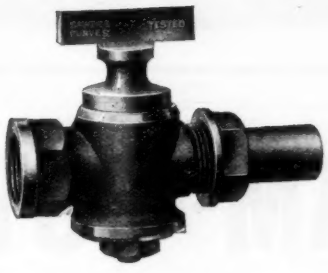

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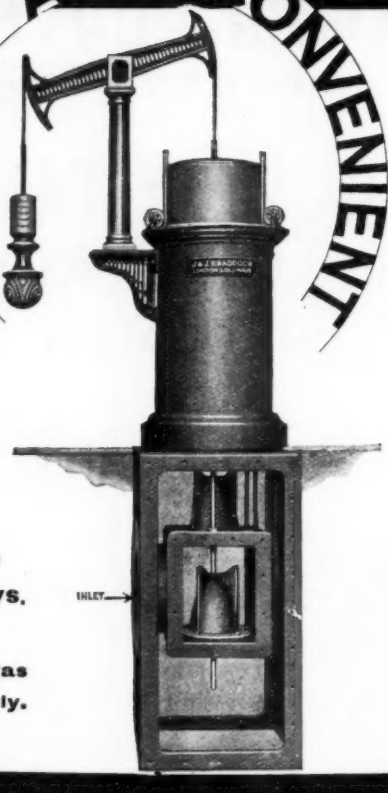

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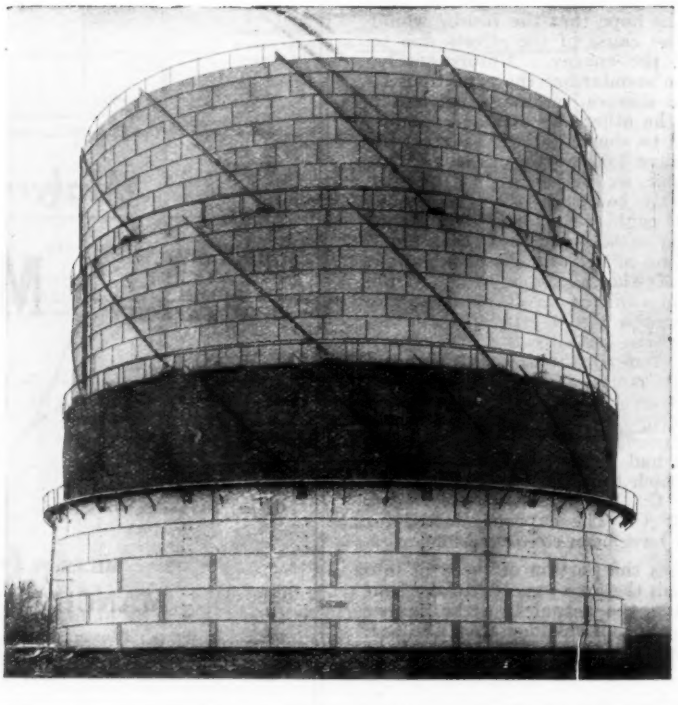

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Telegraphic Address: RETORTUS, SOWEST LONDON

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Gas Markets and Manufactures

Stock Market Report.

[For Stock and Share List, see later page.]

The feature of last week's business on the Stock Exchange was the strength of leading Industrials, especially tobacco, brewery, and motor shares, and with buyers predominating prices hardened appreciably. The big demand in this market, however, led at one time to a set-back in gilt-edged securities, but though these subsequently became firmer the movement was too late to effect a complete restoration to former values.

Firm conditions were maintained in the Gas market, and the volume of business was well up to the average. The feature was a sharp rise in Oriental ordinary of 7 points to 164½. A year ago this stock stood at 116½ when the previous year's dividend was 8%, less tax, but the good results obtained for the year 1933 enabled the Directors to distribute a similar rate of dividend free of tax. The yield on this basis at the current price works out at £6 5s. 8d.%, so that, having regard to the Company's strong financial position, the large appreciation is amply justified. On the other hand, there seems to be no apparent reason for the drop of 7 points in the Plymouth and Stonehouse stock to 162½. The last recorded transaction was in July at 172, and the Portsmouth stock, paying a similar rate of dividend (8%), is quoted at 168½ *ex* div. British ordinary and 4% debenture both rose 3, and it will be seen in the Stock and Share List that several smaller gains were recorded, while many ordinary and preference stocks became *ex* div. on Aug. 13.

Current Sales of Gas Products.

The London Market for Tar Products.

LONDON, *Aug.* 20.

Business in the Tar Products market has been quiet during the past week, with prices steady at the following levels:

Pitch, about 57s. 6d. per ton f.o.b.
Creosote, 4d. to 4¼d. per gallon.
Refined Tar, 4d. to 4¼d. per gallon in bulk at makers' works.
Pure Toluole, about 2s. 2d. to 2s. 3d.
Pure Benzole, 1s. 9d. to 1s. 10d.; 95/160 solvent naphtha, 1s. 7d. to 1s. 8d.; and 90/160 pyridine, 7s. to 7s. 6d.—all per gallon naked at makers' works.

Tar Products in the Provinces.

Aug. 20.

The average prices of gas-works products during the week were: Gas-works tar, 25s. to 30s.; Pitch—East Coast, 55s. to 57s. 6d. f.o.b. West Coast—Manchester, Liverpool, Clyde, 55s. to 57s. 6d.* Toluole, naked, North, 1s. 8d. to 1s. 10d. Coal-tar crude naphtha, in bulk, North, 6¼d. to 6¾d. Solvent naphtha, naked, North, 1s. 5d. to 1s. 6d. Heavy naphtha, North, 9¾d. to 10¾d. Creosote, *ex* works, in bulk, North, liquid and salty, 3⅞d. to 3¼d.; low gravity, 3d. to 3¼d.; Scotland, 3d. to 3¼d. Heavy oils, in bulk, North, 3¾d. to 4¼d. Carbolic acid, 60's, 1s. 10d. to 1s. 11d. Naphthalene, £10 to £11. Salts, 55s. to 75s., bags included. Anthracene, "A" quality, 2½d. to 3d. per minimum 40%, purely nominal; "B" quality, unsalable.

* All prices for pitch are now quoted on the basis of f.o.b. In order to arrive at the f.a.s. value at any port it will be necessary to deduct the loading costs and the tolls whatever they may be.

Tar Products in Scotland.

GLASGOW, *Aug.* 18.

A quiet, steady throughput is being maintained in this district and prices of most products are well held.

Crude gas-works tar.—The actual value remains at 34s. to 36s. per ton *ex* works in bulk.

Pitch remains lifeless, with values nominal at 45s. per ton f.o.b. Glasgow for export, and 42s. 6d. to 45s. per ton *ex* works in bulk for home trade.

Refined tar.—Quotations are maintained at 3d. to 3¼d. per gallon in buyers' packages at makers' works.

Creosote oil.—This product is still finding a ready outlet and prices are steady to firm. B.E.S.A. Specification oil is 4d. to 4¼d. per gallon; low gravity, 4½d. to 4¾d. per gallon; and neutral oil, 4¼d. to 4½d. per gallon; all f.o.r. in bulk.

Cresylic acid.—While new business is not too plentiful, the prices are unchanged. Pale, 97/99%, is 1s. 3d. to 1s. 4d. per gallon; dark, 97/99%, 1s. 0½d. to 1s. 1½d. per gallon; and pale, 99/100%, 1s. 4½d. to 1s. 5½d. per gallon; all *ex* works.

Crude naphtha is valued at 4¾d. to 5¼d. per gallon, according to quality.

Solvent naphtha.—90/160 grade is 1s. 3d. to 1s. 4d. per gallon, and 90/190 grade 8d. per gallon.

Motor benzole.—Value is nominal at 1s. 5d. per gallon.

Pyridines.—90/160 grade is 6s. to 7s. per gallon, and 90/140 grade 7s. to 8s. per gallon (nominal).

Benzole Prices.

These are considered to be the market prices for benzole at the present time:

	s. d.		s. d.	
Crude benzole . . .	0 9	to	0 9½	per gallon at works
Motor ,, . . .	1 3½	,,	1 4	,, ,, ,,
90% ,, . . .	1 4	,,	1 4½	,, ,, ,,
Pure ,, . . .	1 7½	,,	1 8	,, ,, ,,

Contracts Advertised To-Day.

Coal.
Selby Gas Department. [p. 430.]

Condenser.
Thornton Cleveleys Gas Department. [p. 430.]

Gasholder and Tank, &c.
Thornton Cleveleys Gas Department. [p. 430.]

Meter (Connersville Type).
Thornton Cleveleys Gas Department. [p. 430.]

Pipes, &c.
Thornton Cleveleys Gas Department. [p. 430.]

Producer Gas Plant.
Thornton Cleveleys Gas Department. [p. 430.]

Purifiers, &c.
Thornton Cleveleys Gas Department. [p. 430.]

Station Governor.
Thornton Cleveleys Gas Department. [p. 430.]

Tar Extractor.
Thornton Cleveleys Gas Department. [p. 430.]

Trade Notes.

Abbott, Birks, & Co.

We have been notified that the new address of Messrs. Abbott, Birks, & Co. is Abbirko House, 90-91, Blackfriars Road, S.E. 1. Telephone: Hop 4066 (2 lines).

G. & J. Weir, Ltd.

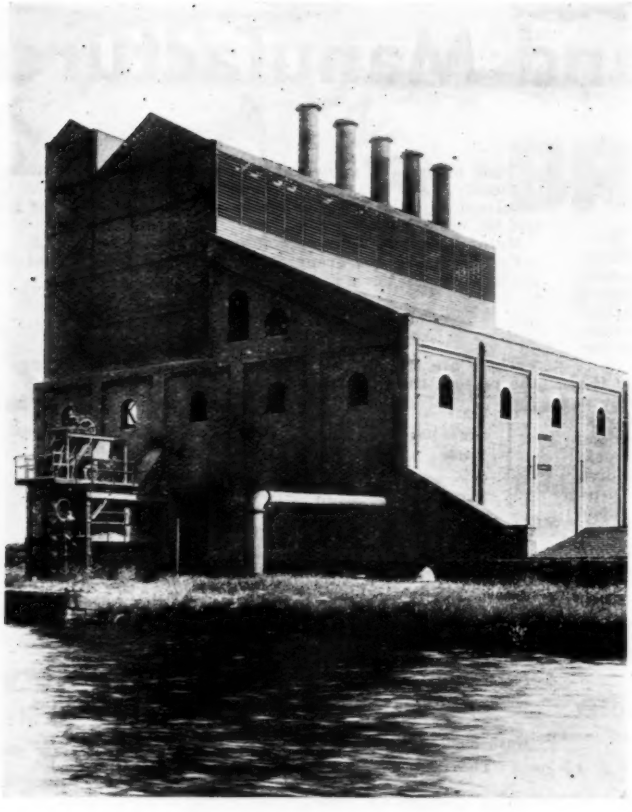
The address of the London office of Messrs. G. & J. Weir, Engineers, Cathcart, Glasgow, S. 4, has been changed since Aug. 15 to: Royal Mail House, Leadenhall Street, E.C.3. The new telephone number is: Mansion House 1985 (3 lines).

Turners Asbestos Cement Company.

We have received pamphlets, from Messrs. Turners Asbestos Cement Company, describing some of their products. These include "Turnall" glazed panels, asbestos-reinforced aluminium foil for the heat insulation of walls, &c., "Everite" asbestos-cement pressure pipes, rainwater goods and ducts.

Pneumatic Gas Switches.

The Pneumatic Gas Lighting Company, Ltd., who, owing to the development of their business, recently removed to more commodious premises at 37, Farringdon Road, London, E.C. 1, have forwarded a copy of their new and profusely illustrated catalogue. Instructions for fixing their apparatus and spare parts for maintenance are features of the catalogue, and among the many new devices introduced this year may be mentioned the Bakelite cover for the Company's tumbler switch.



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VERTICAL RETORTS

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INTERMITTENT
CARBONIZING CHAMBERS

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LIP-BUCKET CONVEYOR
WITH AUTOMATIC LUBRICATION

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CONVEYORS AND
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STOCK AND SHARE LIST.

Official Quotations on the London and Provincial Stock Exchanges.

Issue. £	Share.	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations. Aug. 17.	Rise or Fall on Week.	Transactions. Lowest and Highest Prices During the Week.
1,551,868	Stk.	Apl. 9	7	7	Alliance & Dublin Ord. ...	130–140	...	139–139½
374,000	„	June 25	4	4	Do. 4 p.c. Deb. ...	90–100	...	...
557,655	„	Aug. 13	7	7	Barnet Ord. 7 p.c.	165–170*	–2	...
300,000	1	May 7	1/4½	1/9¾	Bombay, Ltd.	27/6–29/6	...	28/4½
178,480	Stk.	Aug. 13	9½	9½	Bournemouth sliding scale	212–217*	–3	...
550,050	„	„	7	7	Do. 7 p.c. max. ...	166–171*	–2	...
439,160	„	„	6	6	Do. 6 p.c. Pref. ...	140–145*	–2	142
50,000	„	June 11	3	3	Do. 3 p.c. Deb. ...	78–88	...	...
262,025	„	„	4	4	Do. 4 p.c. Deb. ...	103–108	...	...
335,000	„	„	5	5	Do. 5 p.c. Deb. ...	122–127	...	124
357,900	„	Aug. 13	7½	7½	Brighton, &c., 6 p.c. Con. ...	161–166*	–1	164–166
540,000	„	„	6½	6½	Do. 5 p.c. Con. ...	149–154*	–2	...
195,500	„	„	6	6	Do. 6 p.c. B. Pref.	138–143*	–2	...
1,487,500	„	July 9	5	5	Bristol 5 p.c. max.	116–118a	...	...
120,420	„	June 11	4	4	Do. 1st 4 p.c. Deb. ...	102–105 s	...	...
217,870	„	„	4	4	Do. 2nd 4 p.c. Deb. ...	102–105a	...	...
328,790	„	„	5	5	Do. 5 p.c. Deb.	121–123a	...	...
885,000	„	Apl. 9	7	8	British Ord.	158–163	+3	159–162
100,000	„	June 11	7	7	Do. 7 p.c. Pref.	154–159	...	156–157½
350,000	„	„	5½	5½	Do. 5½ p.c. Pref.	104–109	...	...
120,000	„	„	4	4	Do. 4 p.c. Red. Deb. ...	98–103	+3	99
450,000	„	„	5	5	Do. 5 p.c. Red. Deb. ...	107–112	...	...
160,000	„	June 11	5	5	Cambridge 5 p.c. Deb. ...	115–120	...	...
100,000	10	22 May '33	6	4	Cape Town, Ltd.	2–4	...	...
100,000	10	Nov. 6	4½	4½	Do. 4½ p.c. Pref. ...	5–7	...	...
150,000	Stk.	July 23	4½	4½	Do. 4½ p.c. Deb. ...	90–95	...	90–92
626,860	„	July 23	6	6	Cardiff Con. Ord.	129–133	...	...
287,860	„	June 11	5	5	Do. 5 p.c. Red. Deb.	103–108	...	...
157,150	„	July 23	6½	5	Chester 5 p.c. Ord.	113–118b	...	...
98,936	1	May 7	2/-	2/-	Colombo, Ltd. Ord.	1⅞–1½	...	...
24,500	1	„	1/4½	1/4½	Do. 7 p.c. Pref. ...	19/6–21/6	...	...
609,204	1	Mar. 19	/11'48	/11'48	Colonial Gas Assn. Ltd. Ord.	19/6–21/6	...	...
296,053	1	„	1/8'30	1/8'30	Do. 8 p.c. Pref.	23/6–25/6	...	...
1,775,005	Stk.	July 23	6½	5	Commercial Ord.	118–123	...	120½–122
475,000	„	June 11	3	3	Do. 3 p.c. Deb. ...	82–87	...	88
286,344	„	Aug. 13	5	5	Do. 5 p.c. Deb. ...	118–123*	–2	...
807,560	„	Aug. 13	7	7	Croydon sliding scale ...	162–167*	–2	...
569,590	„	„	5	5	Do. max. div.	103–108*	–2	...
620,395	„	June 25	5	5	Do. 5 p.c. Deb.... ...	119–124	...	123
542,270	„	Aug. 13	10	7	Derby Con.	175–180c*	...	...
55,000	„	June 25	4	4	Do. 4 p.c. Deb.	97–100c	...	...
209,000	„	Aug. 13	6	6	East Hull Ord. 5 p.c. ...	104–109*	–2	107½–108½
181,625	„	Aug. 13	6	6	East Surrey Ord. 5 p.c. ...	126–131*	...	131
175,609	„	June 11	5	5	Do. 5 p.c. Deb. ...	120–125	...	...
1,002,180	„	Apl. 9	†5	†7	European, Ltd.	124–129	–1	125
19,342,763	„	Aug. 13	5⅝	5⅝	Gas Light & Coke 4 p.c. Ord.	26/6–27/-f*	–/6	26/6–27/4½
2,600,000	„	„	3½	3½	Do. 3½ p.c. max. ...	87–90*	–1	88–89½
4,477,106	„	„	4	4	Do. 4 p.c. Con. Pref. ...	104–107*	–1	105–106⅝
6,102,497	„	May 28	3	3	Do. 3 p.c. Con. Deb. ...	86–89	+1	87½–88½
3,642,770	„	„	5	5	Do. 5 p.c. Red. Deb. ...	115–118	...	...
3,500,000	„	„	4½	4½	Do. 4½ p.c. Red. Deb. ...	113–116	...	114–115½
270,466	„	Aug. 13	6	6	Harrogate New Cons. ...	127–132*	–2	...
140,800	1	Apl. 23	1/7½	1/7½	Hongkong & China, Ltd. ...	1⅝–1⅞	...	...
213,200	Stk.	Aug 13	6	6	Hornsey Con. 3½ p.c. ...	127–132*	–1	...
5,600,000	„	May 28	10	14	Imperial Continental Cap.	205–215	...	206–208
223,180	„	July 23	3½	3½	Do. 3½ p.c. Red. Deb.	92–97*	...	...
235,242	„	Aug. 13	8½	8½	Lea Bridge 5 p.c. Ord. ...	163–172*	–2½	...
2,167,410	„	Aug. 13	6	6	Liverpool 5 p.c. Ord. ...	131–132b*	–2	...
245,500	„	June 11	5	5	Do 5 p.c. Red. Pref. ...	101–111b	...	...
306,083	„	July 16	4	4	Do. 4 p.c. Deb. ...	100½–102½b	...	...
165,786	„	Feb. 19	8	10	Maidstone 5 p.c. Cap. ...	180–190	...	...
56,176	„	June 25	3	3	Do. 3 p.c. Deb. ...	71–76	...	...
75,000	„	May 28	†10	†10	Malta & Mediterranean ...	200–210	...	...
392,000	—	Apl. 3	5½	5½	Metropolitan (of Melbourne) 5½ p.c. Red. Deb.	101–104	+2	...
231,978	Stk.	Aug. 13	5	5	M. S. Utility "C." Cons. ...	111–116*	–2	113½–114½
818,657	„	„	4	4	Do. 4 p.c. Cons. Pref.	95–100*	–1	98½
360,075	„	June 11	4	4	Do. 4 p.c. Deb. ...	100–105	...	...
148,955	„	„	5	†5	Do. 5 p.c. Deb. ...	119–124	...	...
125,000	—	July 2	...	11/8	Do 3½ p.c. Rd. Rg. Bds.	97–100	...	...
675,000	„	May 28	†6	†13	Montevideo, Ltd.	58–63	–2	59½
2,061,315	„	Aug. 13	5½	5	Newcastle & Gateshead Con.	25/9–26/6d*	–/6	...
682,856	„	„	4	4	Do. 4 p.c. Pref. ...	99½–100½d*	–1½	...
776,706	„	June 11	3½	3½	Do. 3½ p.c. Deb. ...	90½–91½d	...	...
277,285	„	May 7	5	5	Do. 5 p.c. Deb. '48 ...	103–107d	...	...
274,000	„	Aug. 13	5	5	Newport (Mon.) 5 p.c. max.	105–107a*	–2	...
204,940	„	Aug. 13	7½	7½	North Middlesex 6 p.c. Con.	153–158*	–2	...
396,160	„	Aug. 13	5	5	Northampton 5 p.c. max. ...	102–107*	–2	...
300,000	„	May 7	†5	†7	Oriental, Ltd.	162–167	+7	162½–166½
416,617	„	June 11	8	8	Plym'th & Stonehouse 5 p.c.	160–165	–7	...
604,416	„	Aug. 13	8	8	Portsm'th Con. Stk. 4 p.c. Std	166–171*	–2	...
241,446	„	„	6	6	Do. 5 p.c. max. ...	103–108*	–2	...
114,000	„	July 23	5	5	Preston 5 p.c. Pref.	101–106	...	...
1,736,968	Stk.	Mar. 19	6	6	Sheffield Cons.	139–141e	...	...
95,000	„	July 9	4	4	Do. 4 p.c. Deb.	100–104e	...	...
133,301	„	Aug. 13	5	P§	Shrewsbury 5 p.c. Ord. ...	137–142*	...	...
90,000	10	May 28	†4	‡8	South African	2–4	...	...
889,695	1	May 7	1/2½	1/2½	South East'n Gas Cn. Ld Ord.	27/9–28/9	...	28/3–28/9
736,061	1	Apl. 9	-/10½	-/10½	Do. 4½ p.c. Red. Cum. Pref	21/9–29/9	...	28/3
450,000	Stk.	Aug. 13	7½‡	4	Do. 4 p.c. Red. Deb. ...	100–102*	–1	...
6,709,895	„	Aug. 13	7	5	South Met. Ord.	135–138*	–1	135–138½
1,135,812	„	„	6	6	Do. 6 p.c. Irred. Pf.	141–146*	–1	143–144½
850,000	„	„	4	4	Do. 4 p.c. Irred. Pf.	102–105*	–1	...
1,895,445	„	June 25	3	3	Do. 3 p.c. Deb. ...	84–87	...	86½
1 000,000	„	July 9	5	5	Do. 5 p.c. Red. Deb.	113–116	...	...
209,830	„	Aug. 13	8½	8½	South Shields Con.	164–166d*	–2	...
1,543,795	„	July 9	6	6	South Suburban Ord. 5 p.c.	133–136	...	132½–133
512,825	„	„	5	5	Do. 5 p.c. Pref.	120–125	...	...
300,000	„	„	4	4	Do. 4 p.c. Pref.	101–106	...	104½
868,837	„	June 11	5	5	Do. 5 p.c. Deb.	121–126	...	123½ 125½
100,000	„	„	4	4	Do. 4 p.c. Deb.	102–107	...	...
647,740	„	Aug. 13	5	5	Southampt'n Ord. 5 p.c. max.	108–113*	–2	...
121,275	„	June 11	4	4	Do. 4 p.c. Deb.	99–104	...	...
350,000	„	Aug. 13	5½	5½	Swansea 5½ p.c. Red. Pref.	107–112*	...	...
200,000	„	June 11	6½	6½	Do. 6½ p.c. Red. Deb.	100–105	...	...
1,076,490	„	Aug. 13	6½	6½	Tottenham and District Ord.	152–157*	–2	155–155½
409,835	„	„	5½	5½	Do. 5½ p.c. Pref. ...	125–130*	–1	...
62,235	„	„	5	5	Do. 5 p.c. Pref. ...	113–118*	–2	...
199,005	„	June 11	4	4	Do. 4 p.c. Deb. ...	100–105	+2	101–103
349,110	„	Aug. 13	7	7	Uxbridge, &c., 5 p.c. ...	153–158*	+2	153½–155
88,330	„	„	5	5	Do. 5 p.c. Pref. ...	112–117*	...	...
1,322,220	„	Aug. 13	7	7	Wandsworth Consolidated	157–162*	...	157½–161½
1,096,373	„	„	5	5	Do. 5 p.c. Pref.	119–124*	–2	...
1,317,964	„	June 11	5	5	Do. 5 p.c. Deb.	121–126	...	124
209,300	„	„	...	26/8	Do. 4 p.c. Deb.	104–107	...	...
158,400	„	Aug. 13	6g	5	Winchester W. & G. 5 p.c. Con.	115–120*	...	...

Quotations at:—*a.*—Bristol. *b.*—Liverpool. *c.*—Nottingham. *d.*—Newcastle. *e.*—Sheffield. *f.*—The quotation is per £1 of stock. *g.*—Paid £8, including 10s. on account of back dividends. * Ex. div. † Paid free of income-tax. ‡ For year.

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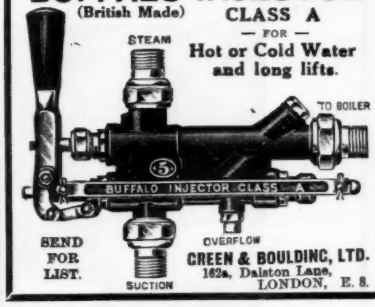

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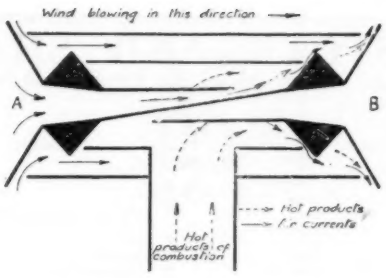

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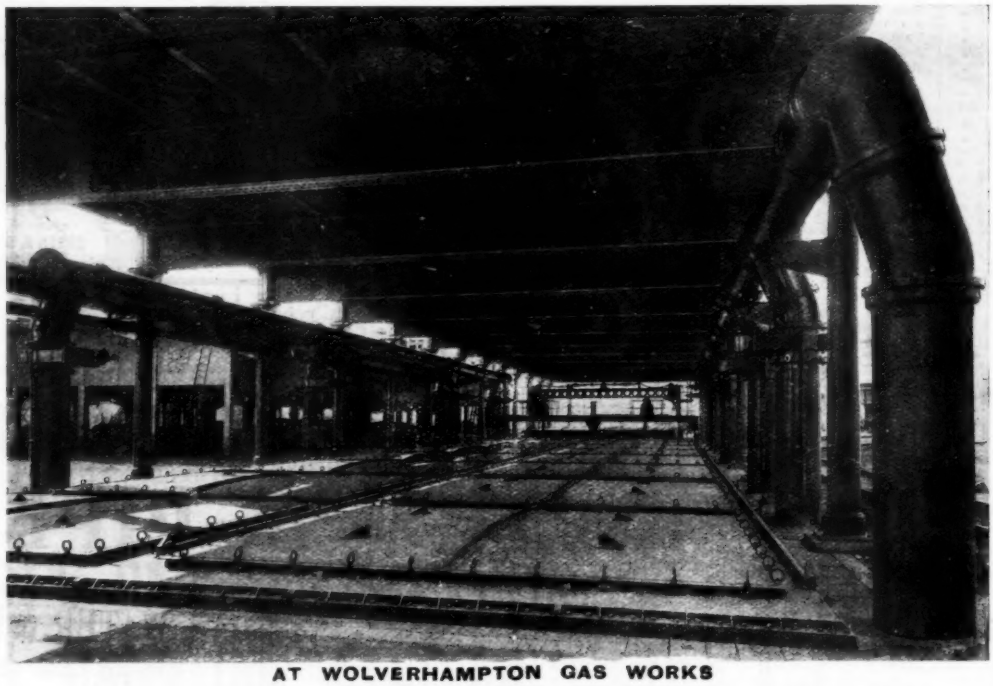

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